US009371653B2

(12) **United States Patent**
Liu

(10) **Patent No.: US 9,371,653 B2**
(45) **Date of Patent: Jun. 21, 2016**

(54) **JOINT STRUCTURE FOR ASSEMBLING FLOORBOARDS**

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(72) Inventor: **Qianyi Liu**, Guangzhou (CN)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/950,312**

(22) Filed: **Jul. 25, 2013**

(65) **Prior Publication Data**

US 2013/0305650 A1 Nov. 21, 2013

Related U.S. Application Data

(63) Continuation-in-part of application No. PCT/CN2011/002131, filed on Dec. 19, 2011.

(30) **Foreign Application Priority Data**

Jan. 29, 2011 (CN) 2011 1 0035241

(51) **Int. Cl.**
E04F 15/02 (2006.01)

(52) **U.S. Cl.**
CPC ***E04F 15/02033*** (2013.01); ***E04F 15/02038*** (2013.01); *E04F 2201/013* (2013.01); *E04F 2201/0107* (2013.01); *E04F 2201/0138* (2013.01); *E04F 2201/025* (2013.01); *E04F 2201/0535* (2013.01)

(58) **Field of Classification Search**
CPC E04F 15/02033; E04F 15/02038; E04F 2201/0535; E04F 2201/0107; E04F 2201/013; E04F 2201/0138; E04F 2201/025
USPC 52/591.4, 592.1, 592.2, 592.4
See application file for complete search history.

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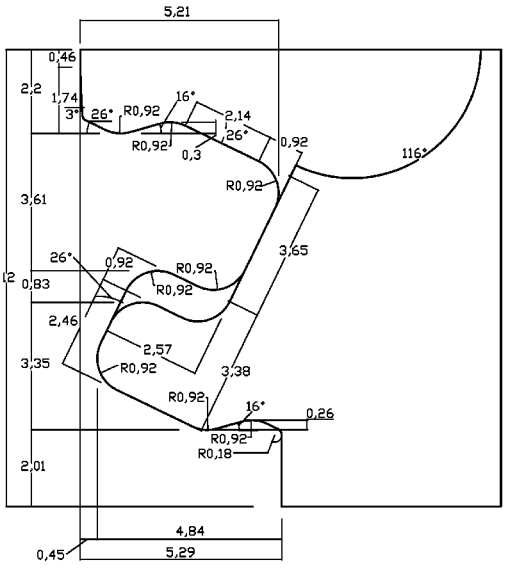
Primary Examiner — Adriana Figueroa
(74) *Attorney, Agent, or Firm* — Matthias Scholl, PC; Matthias Scholl

(57) **ABSTRACT**

A joint structure for a floorboard, including: at least one first beveled tenon, the first beveled tenon including a tenon face facing upwards; a first beveled mortise, the first beveled mortise including a mortise face facing upwards; at least one second beveled tenon, the second beveled tenon including a tenon face facing downwards; and a second beveled mortise, the second beveled mortise including a mortise face facing downwards. The first beveled tenon is disposed in parallel to a surface of the floorboard at a right edge approximately half a height of the floorboard; the first beveled mortise is disposed at an inner side of the first beveled tenon. The second beveled tenon is disposed at a left edge approximately half the height of the floorboard. The second beveled mortise is disposed at an inner side of the second beveled tenon.

5 Claims, 57 Drawing Sheets



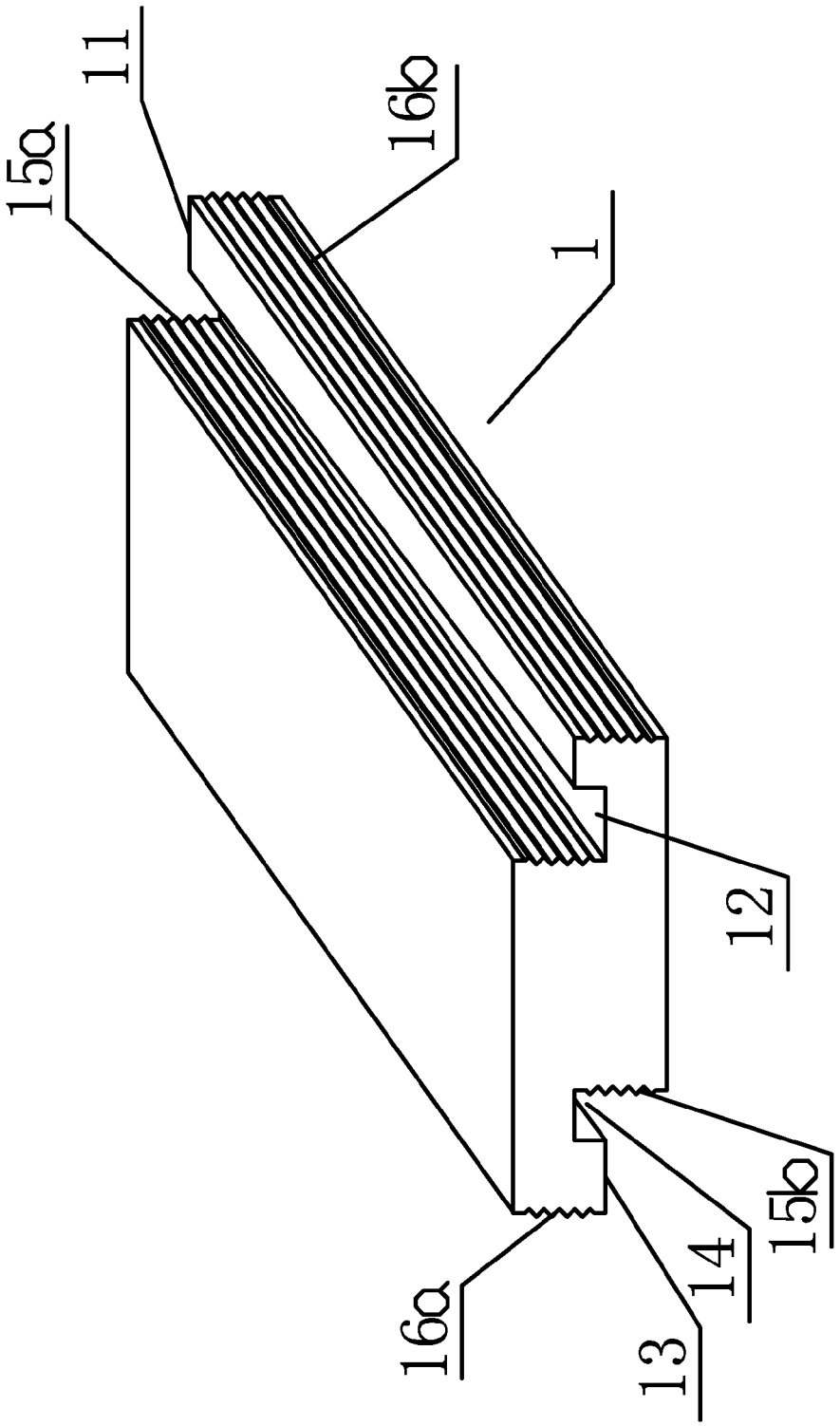


FIG. 1

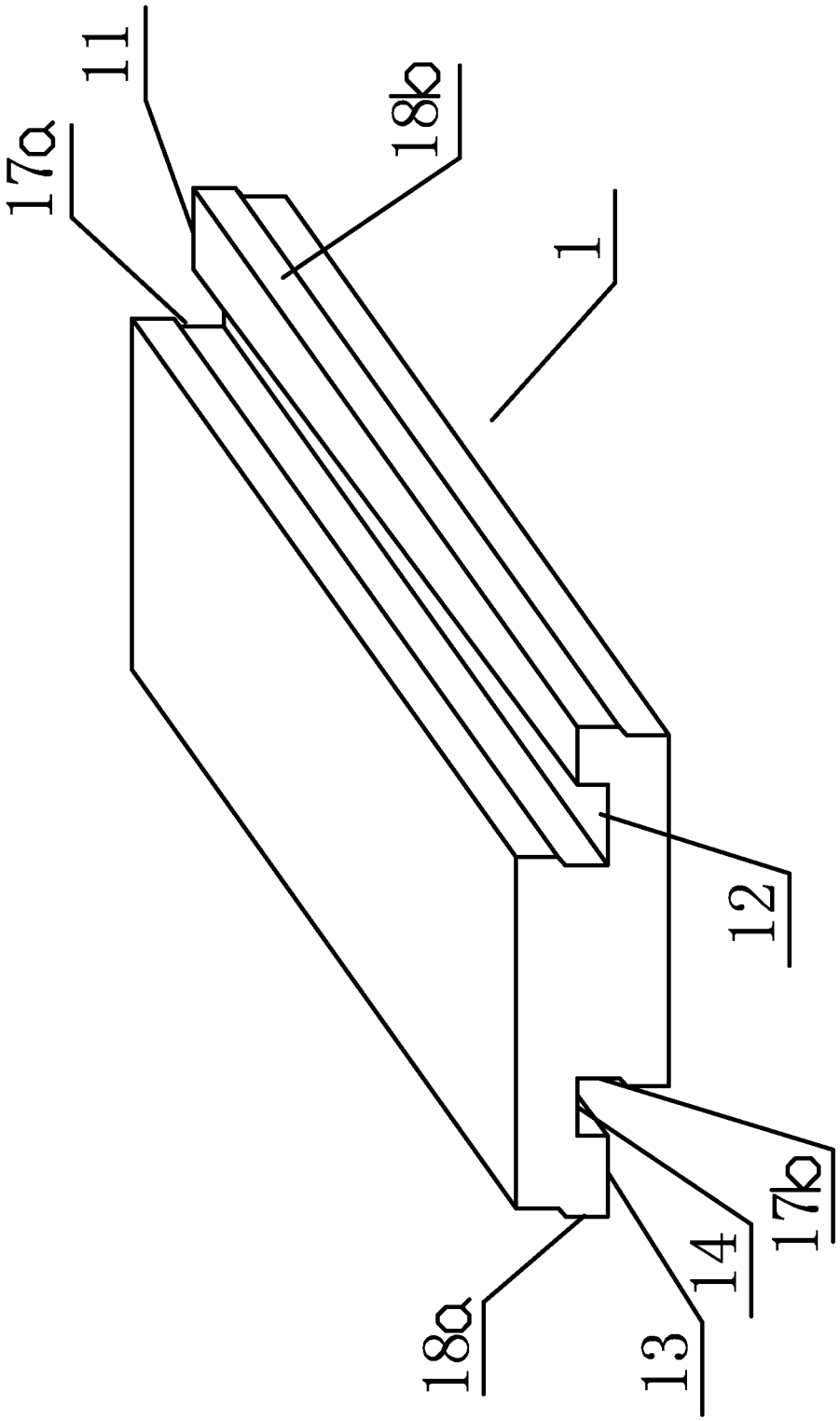


FIG. 2

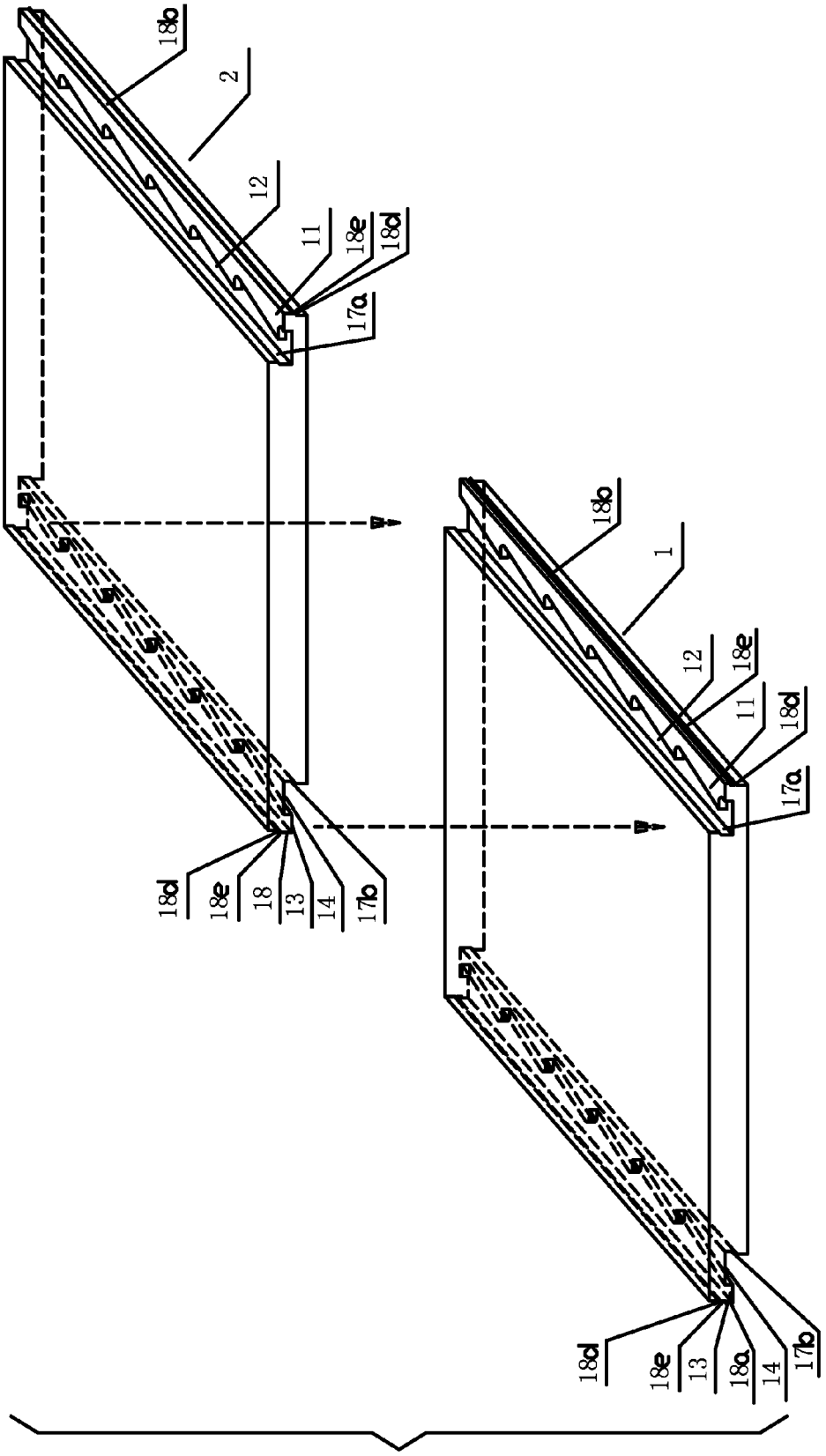

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FIG. 3

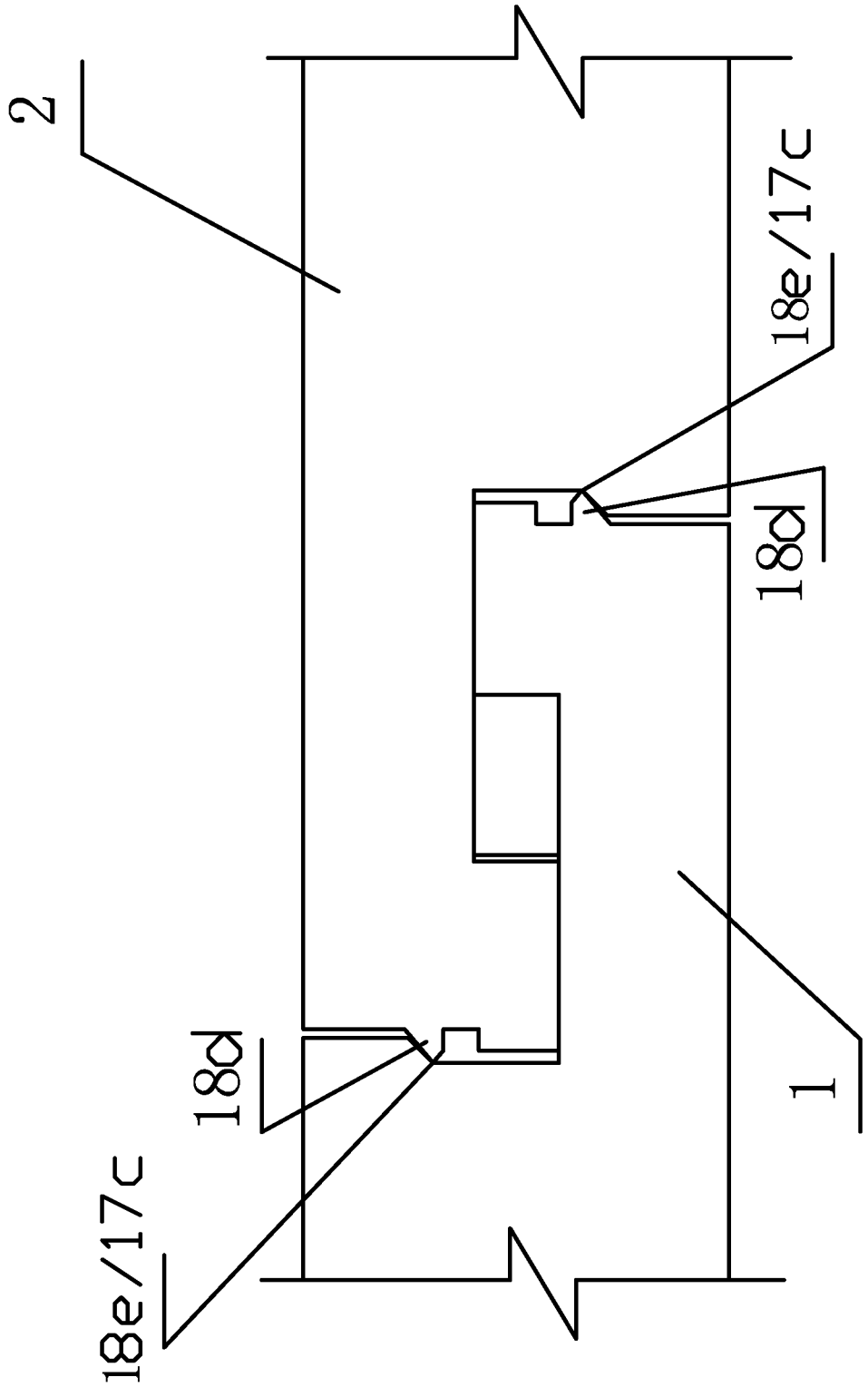

FIG. 4

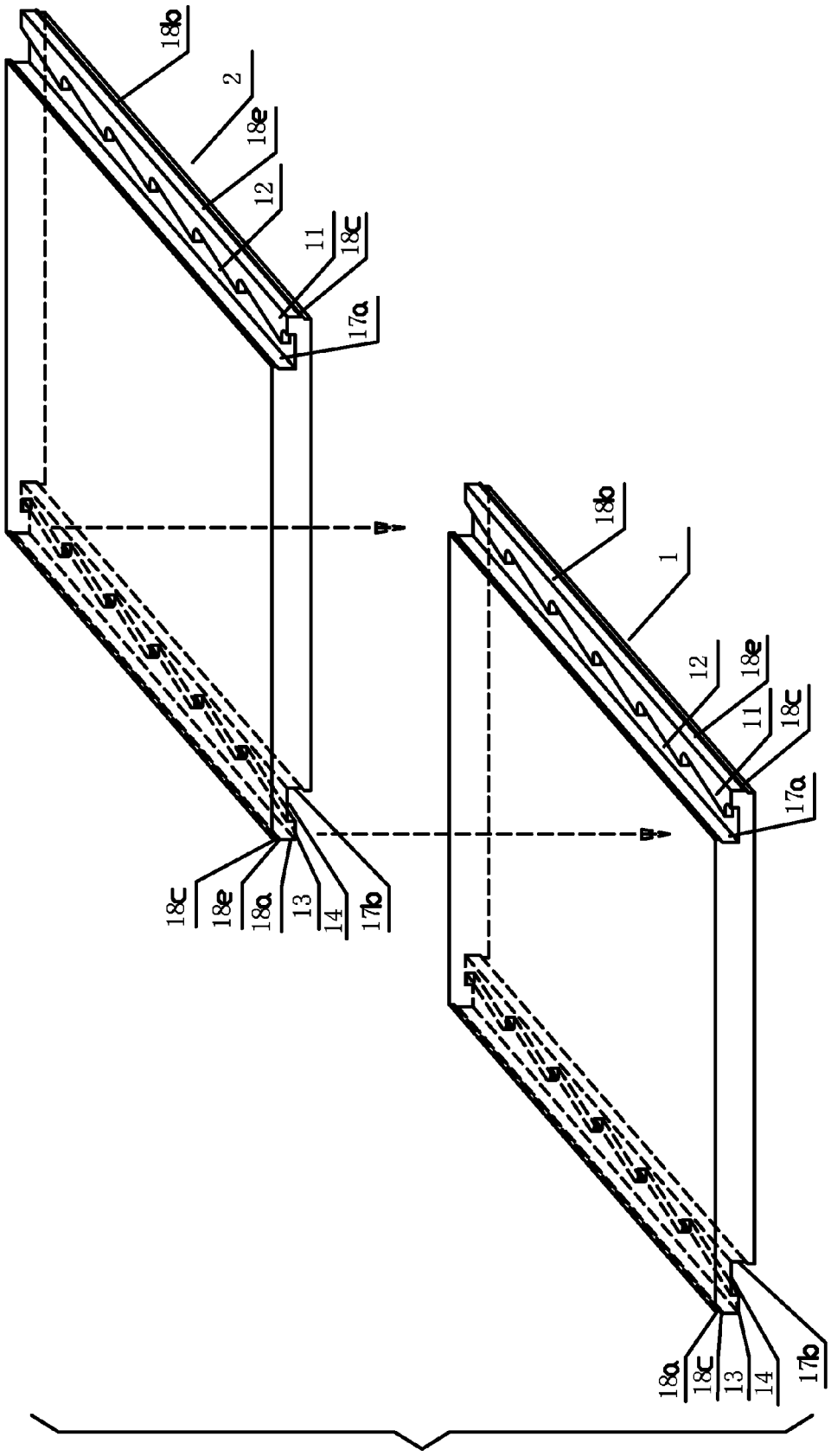
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FIG. 5

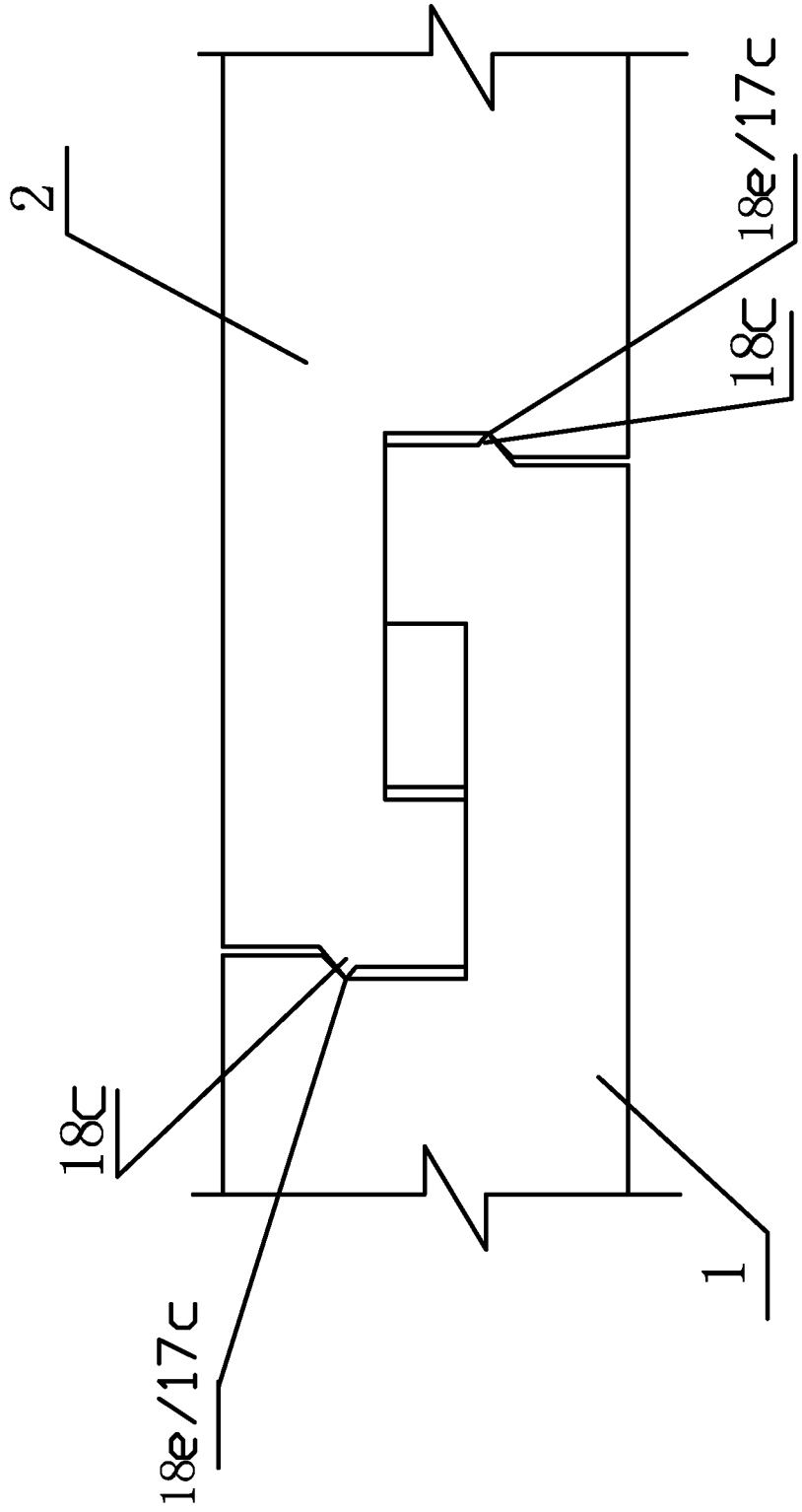
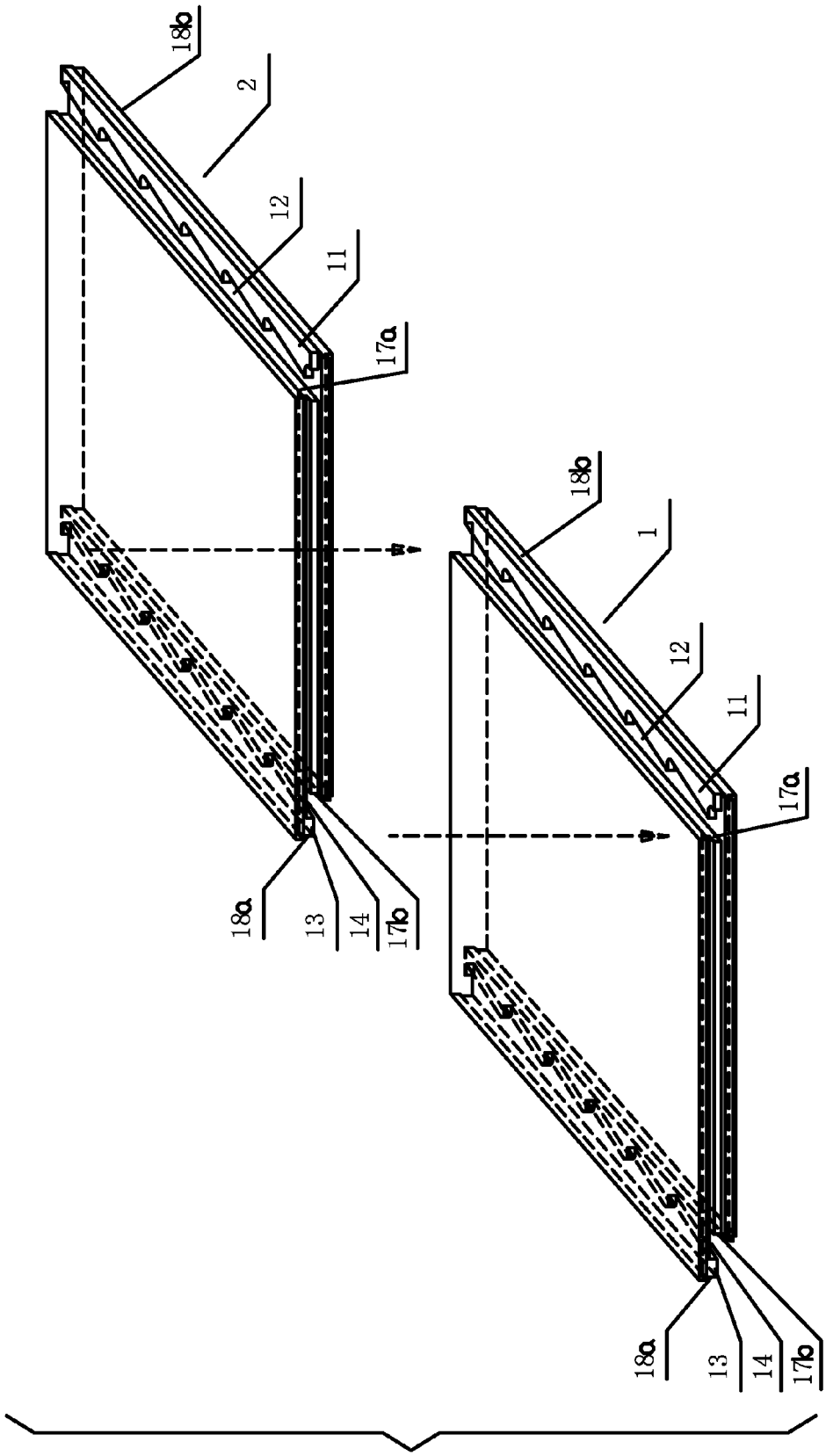


FIG. 6



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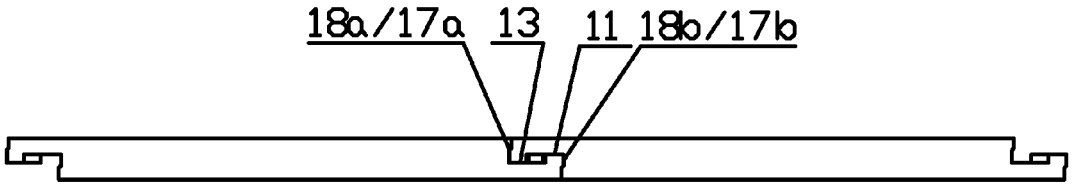

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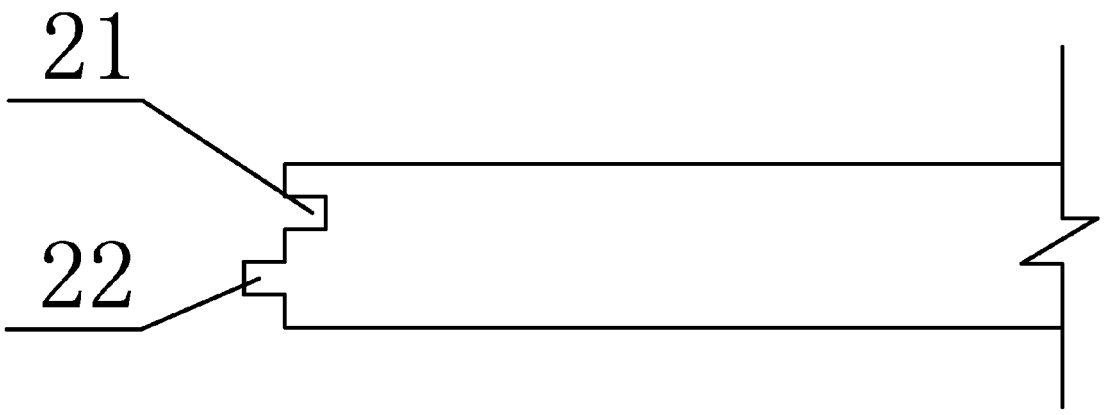

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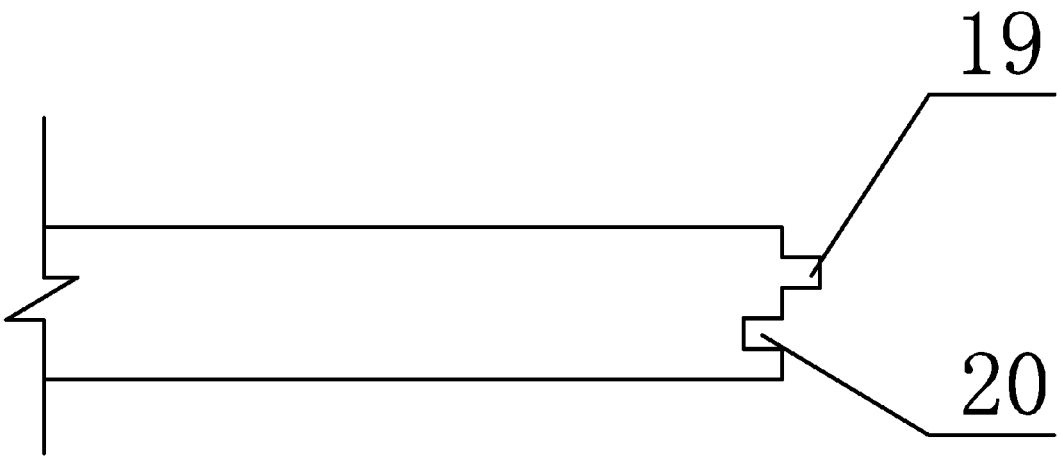

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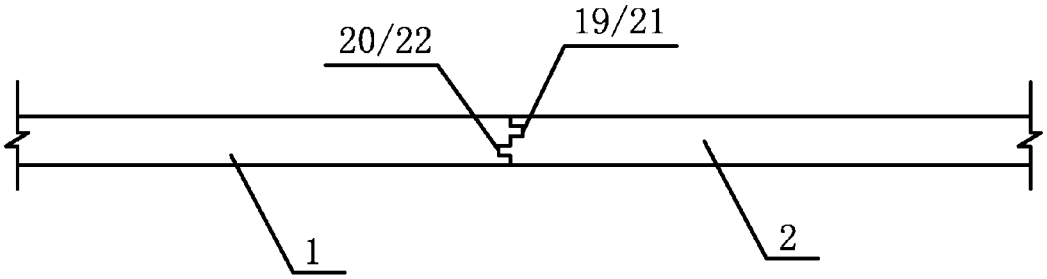

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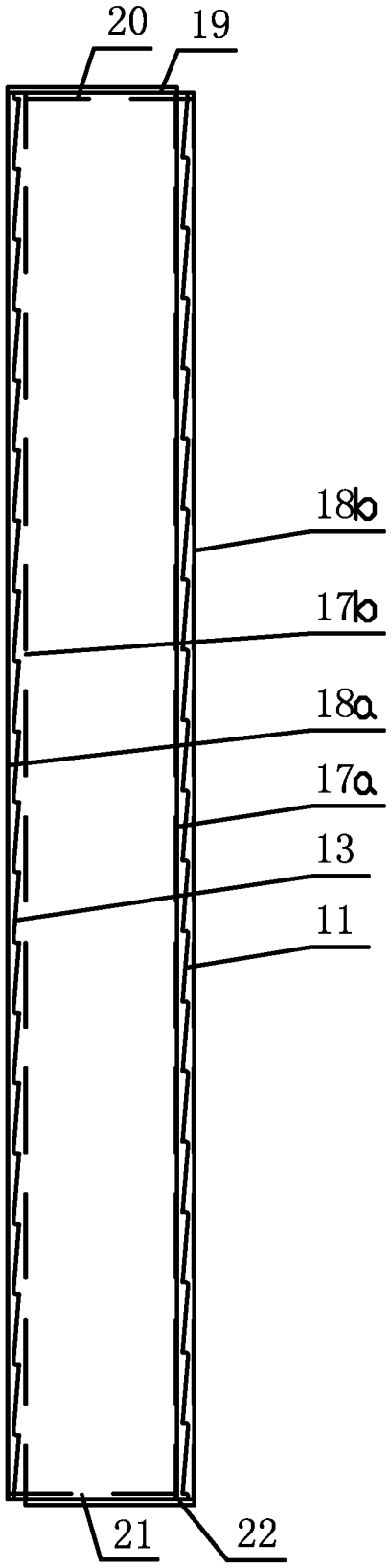
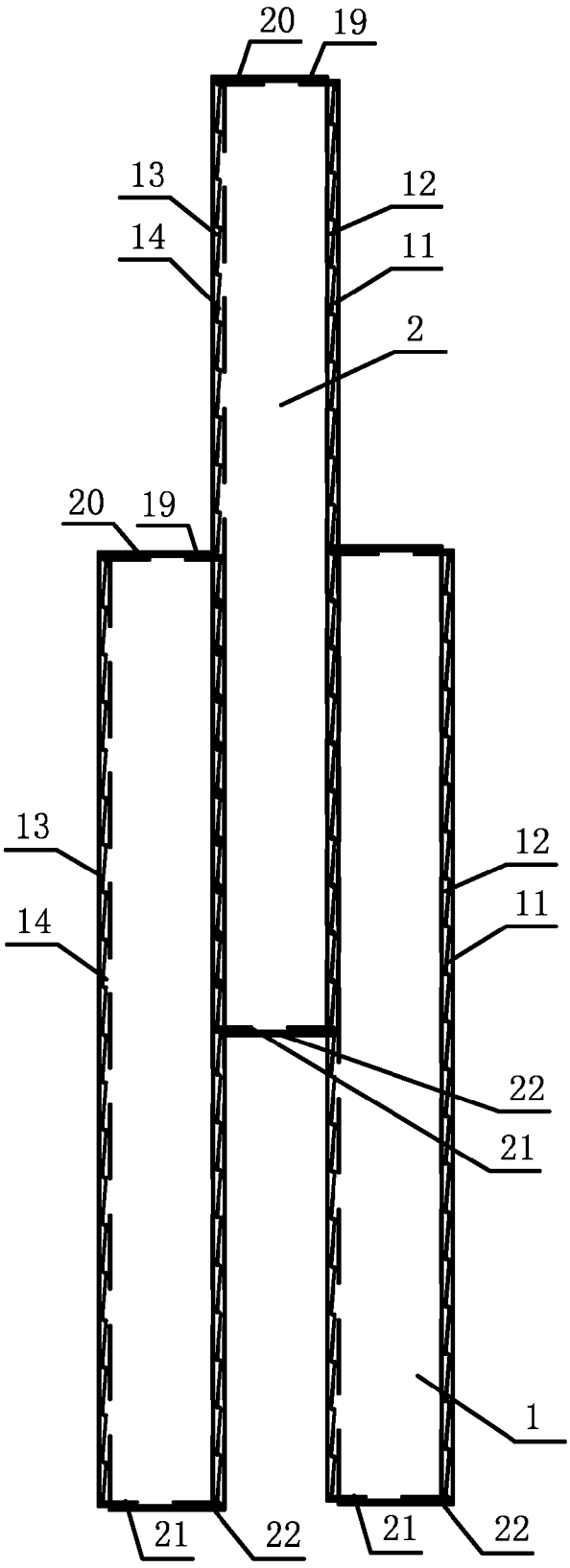


FIG. 12



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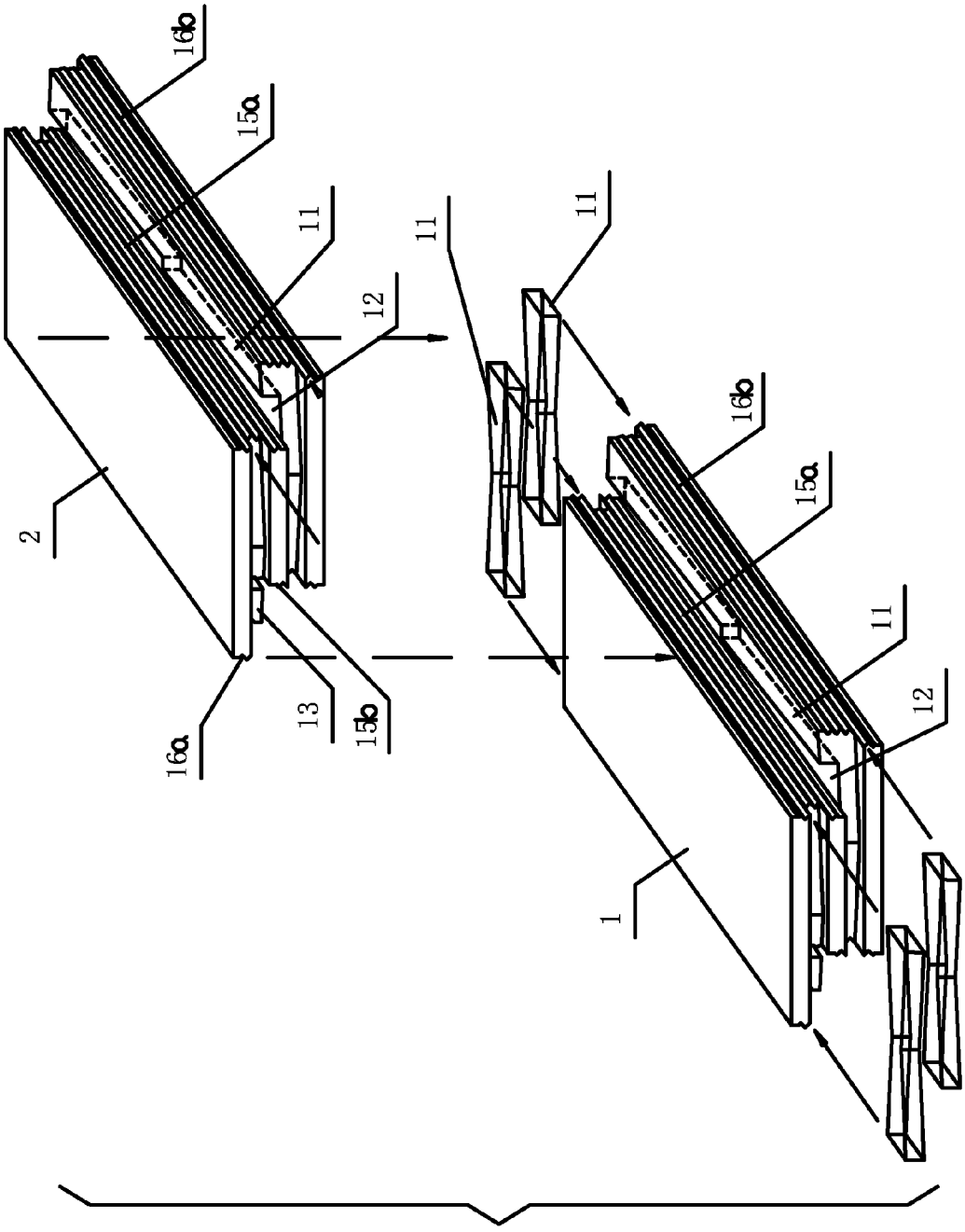

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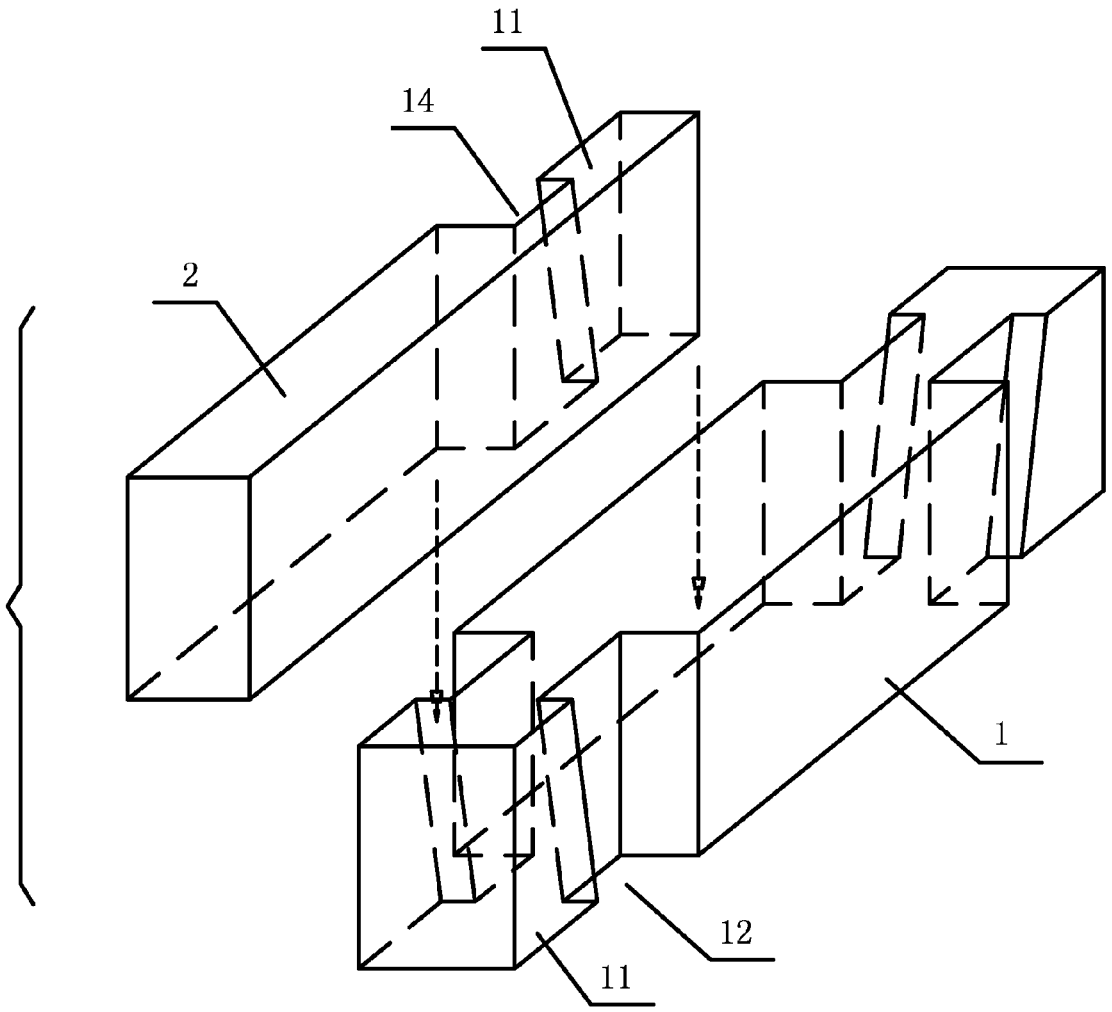

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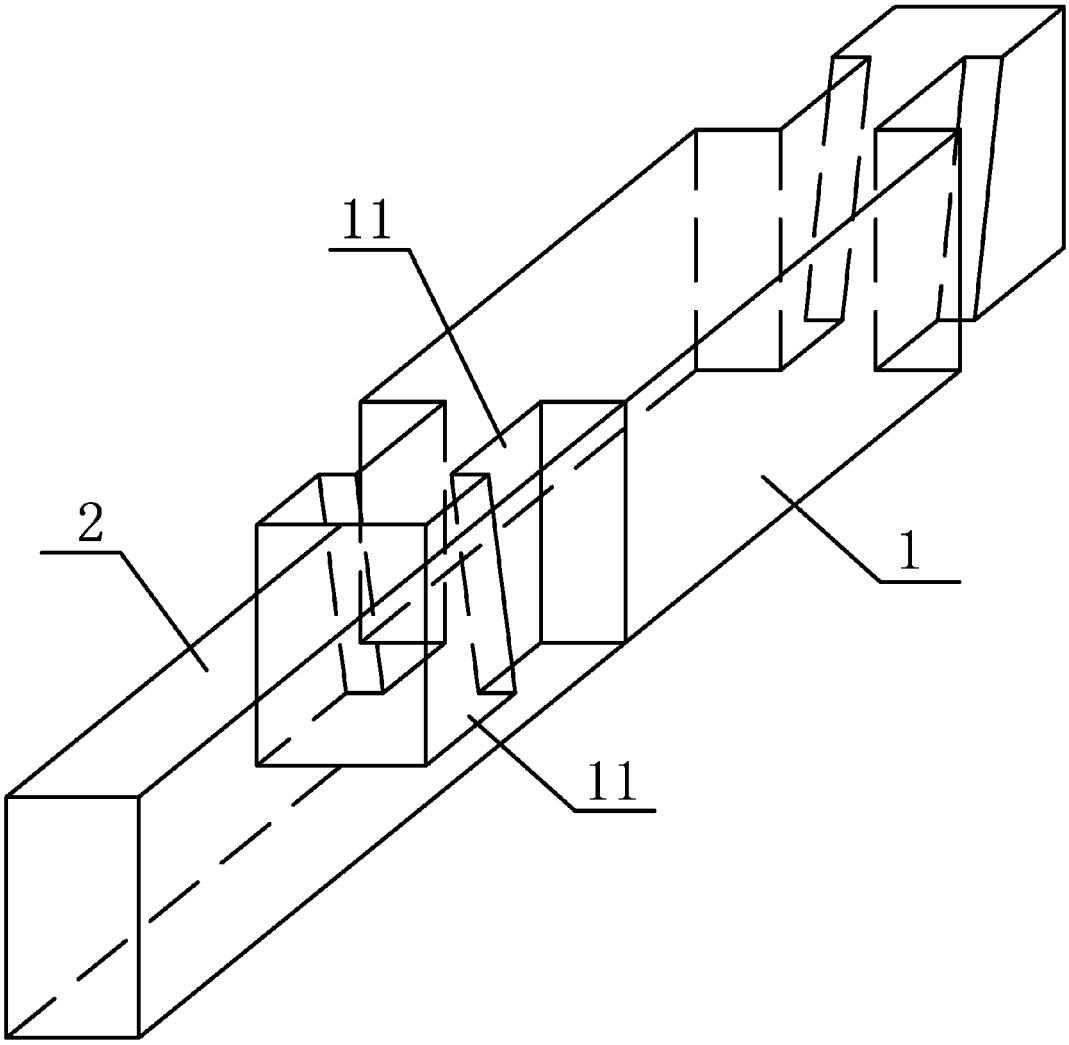


FIG. 16

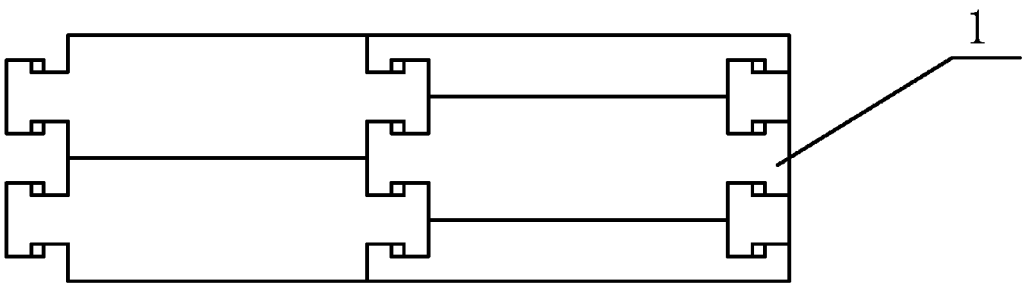


FIG. 17

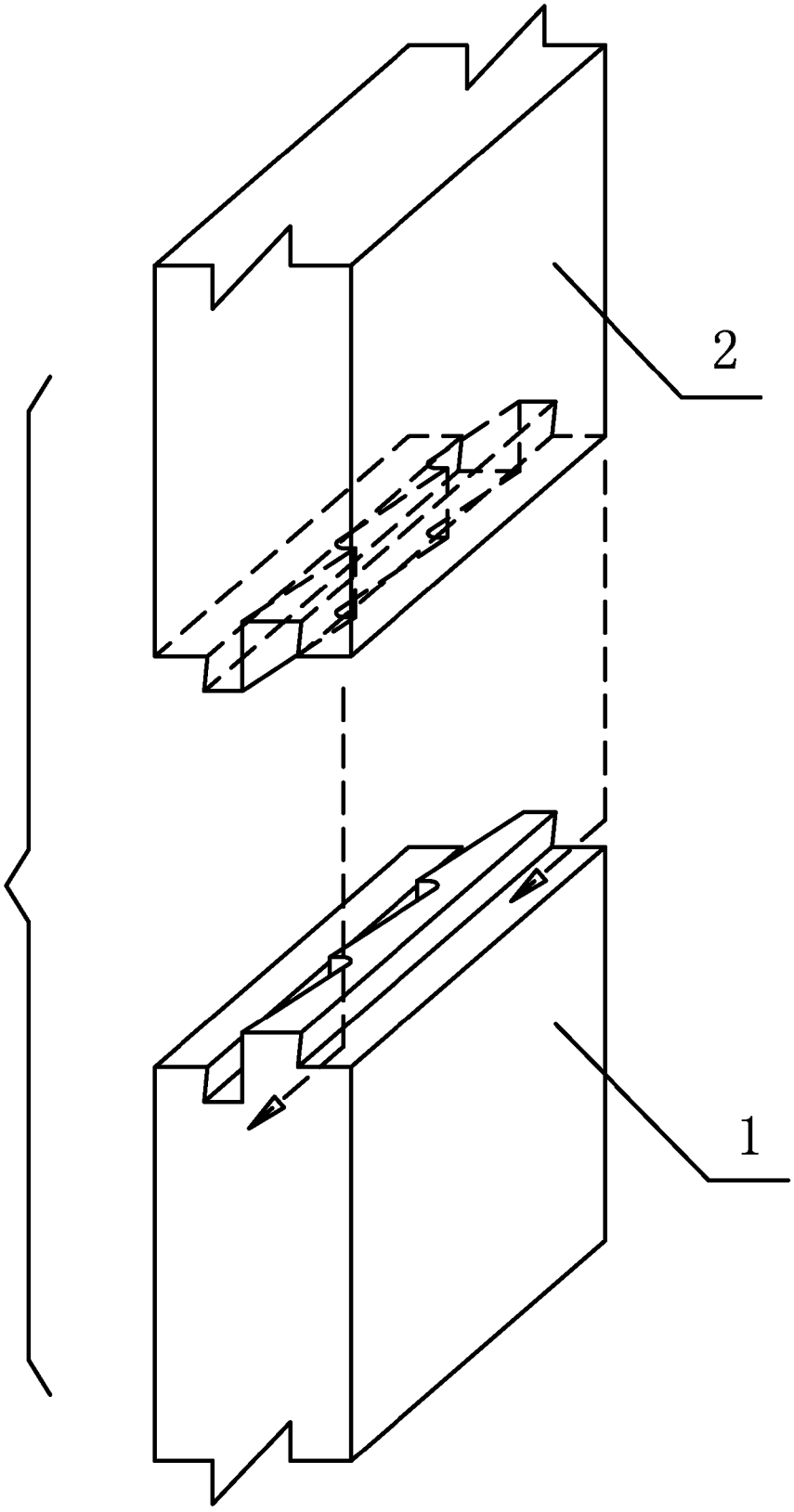
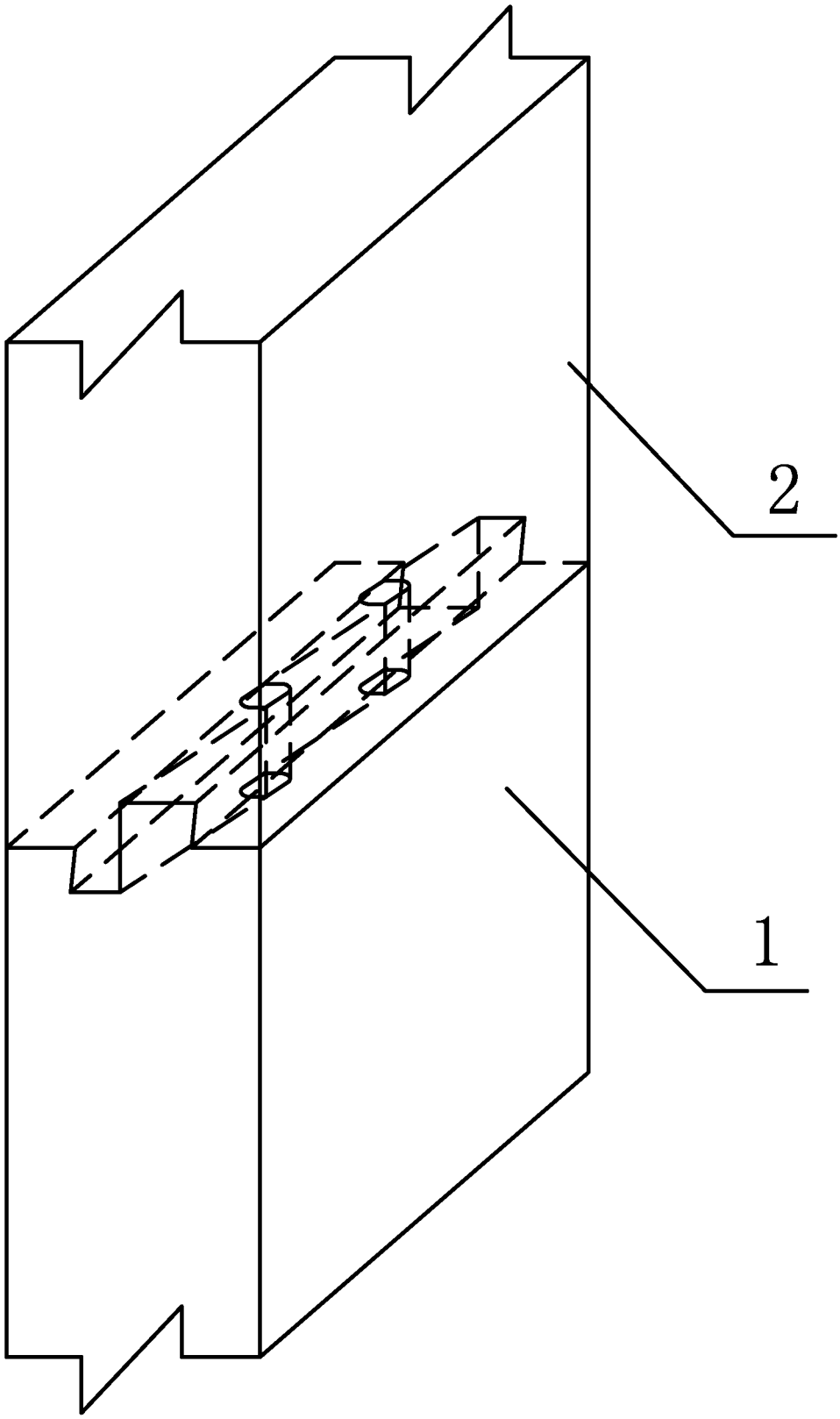


FIG. 18



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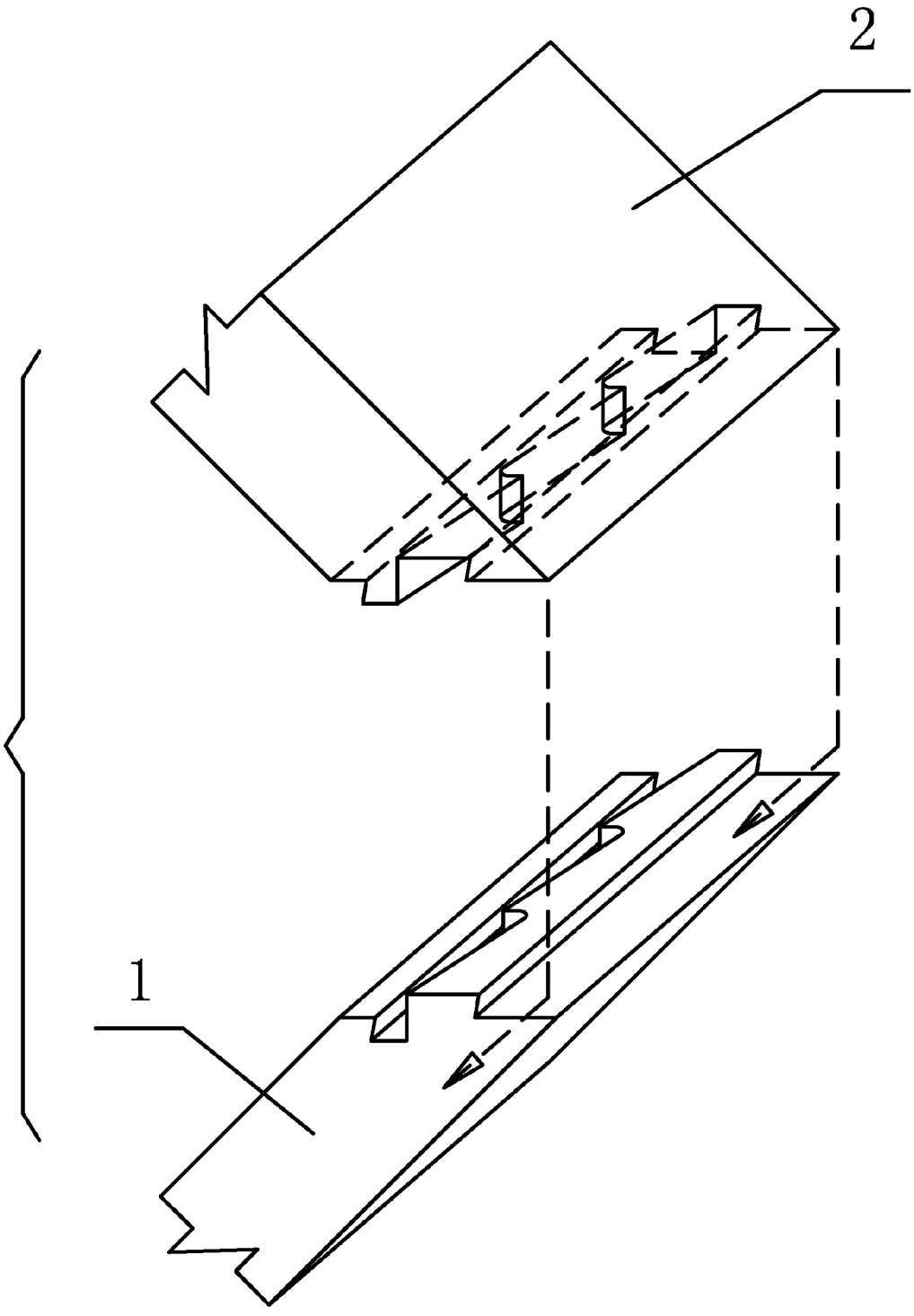

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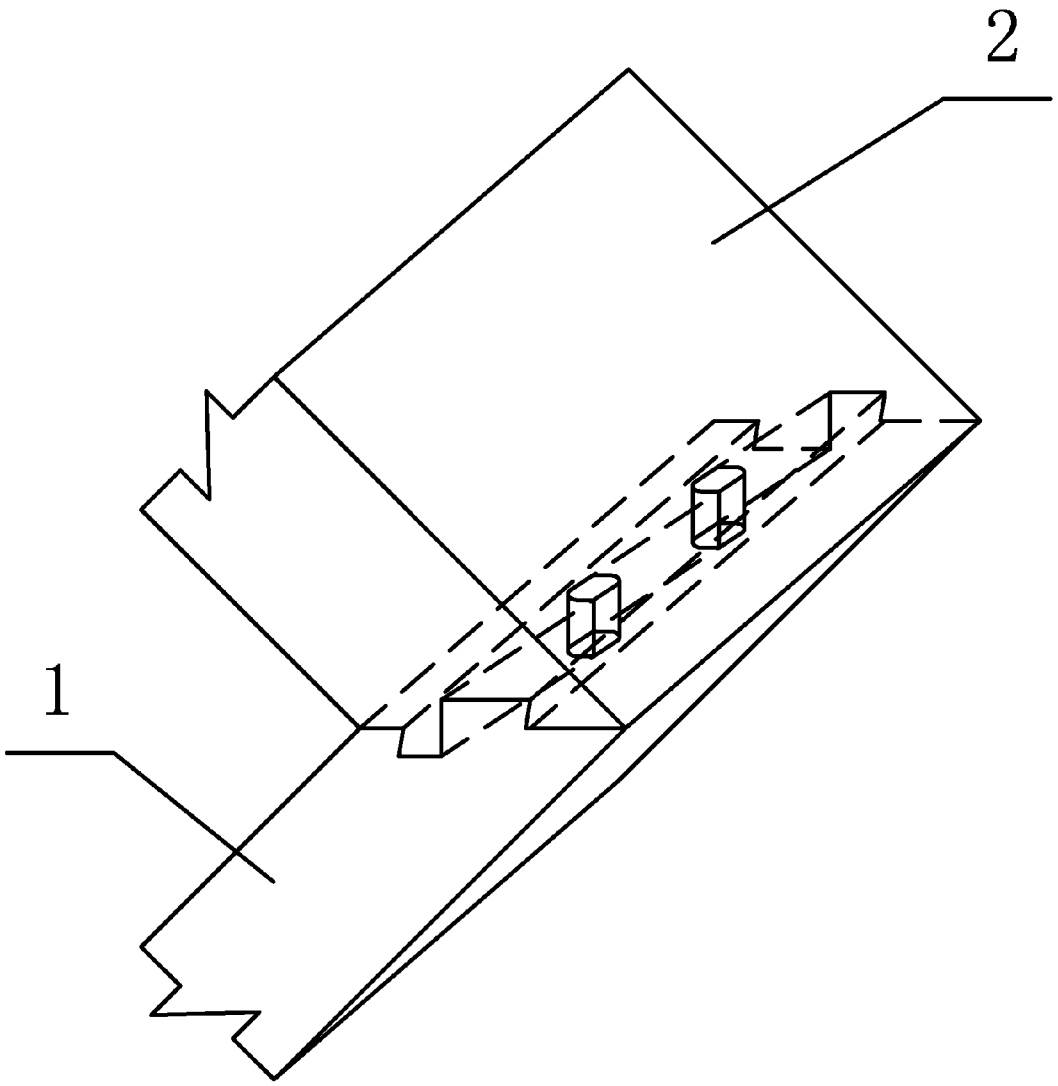

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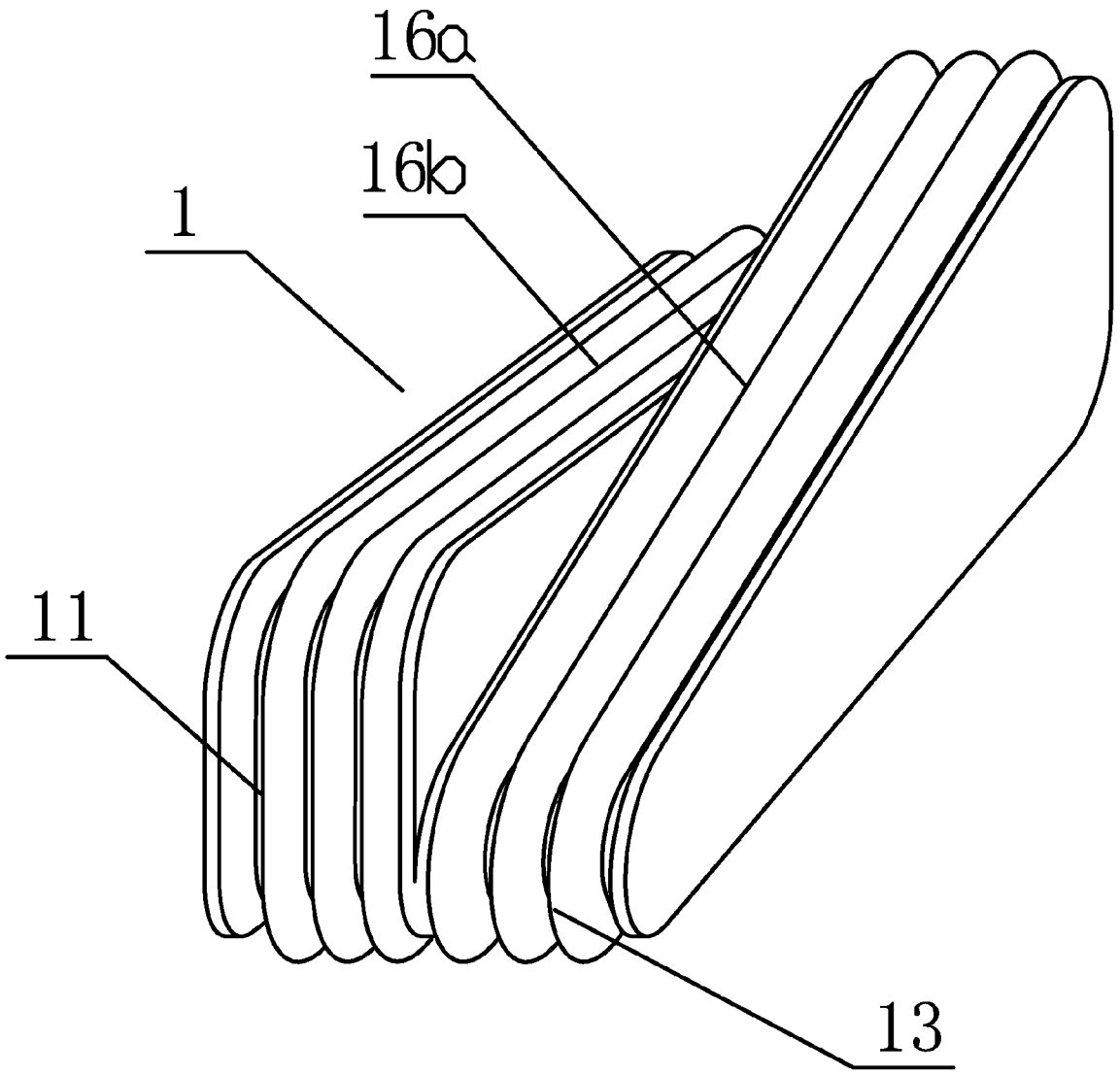
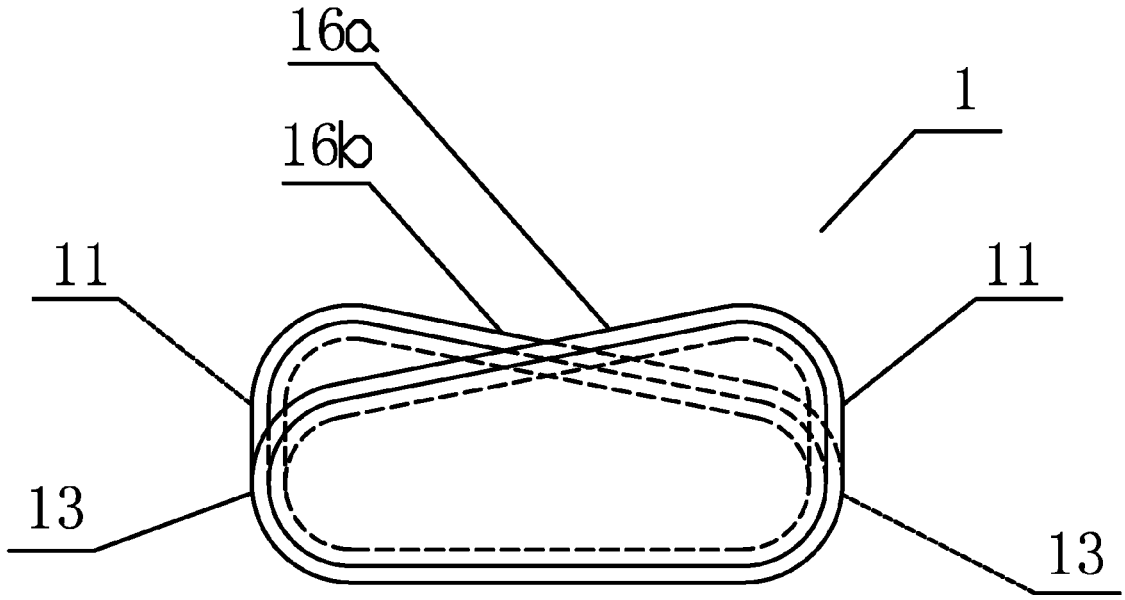


FIG. 22



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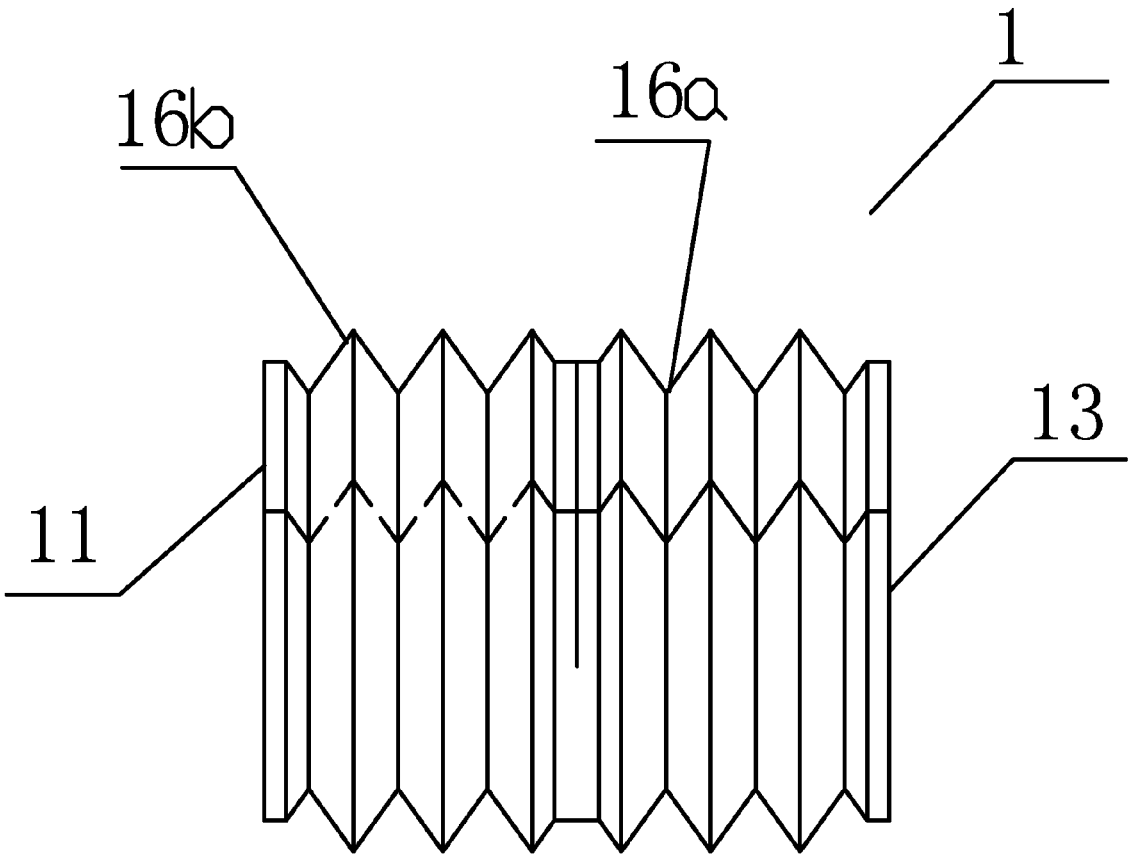

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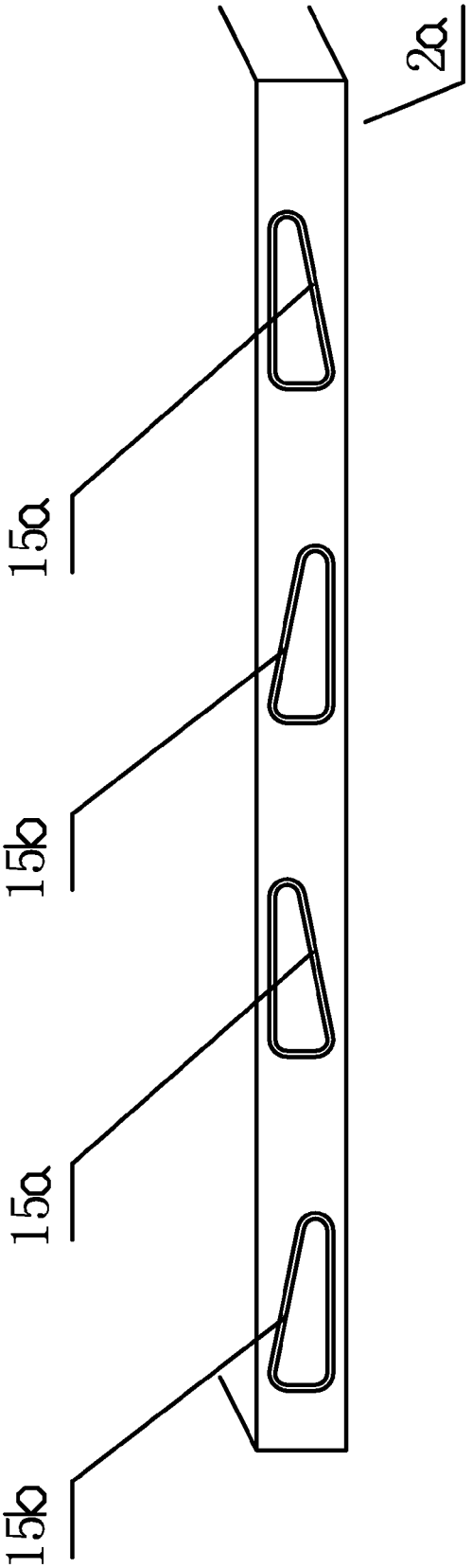

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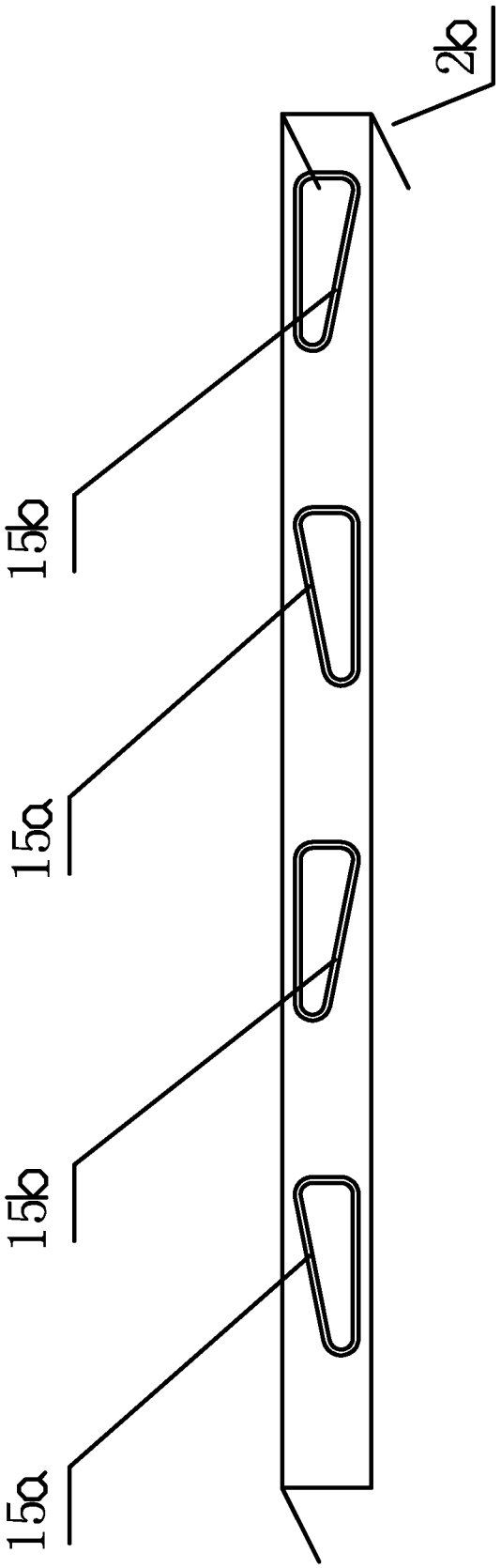

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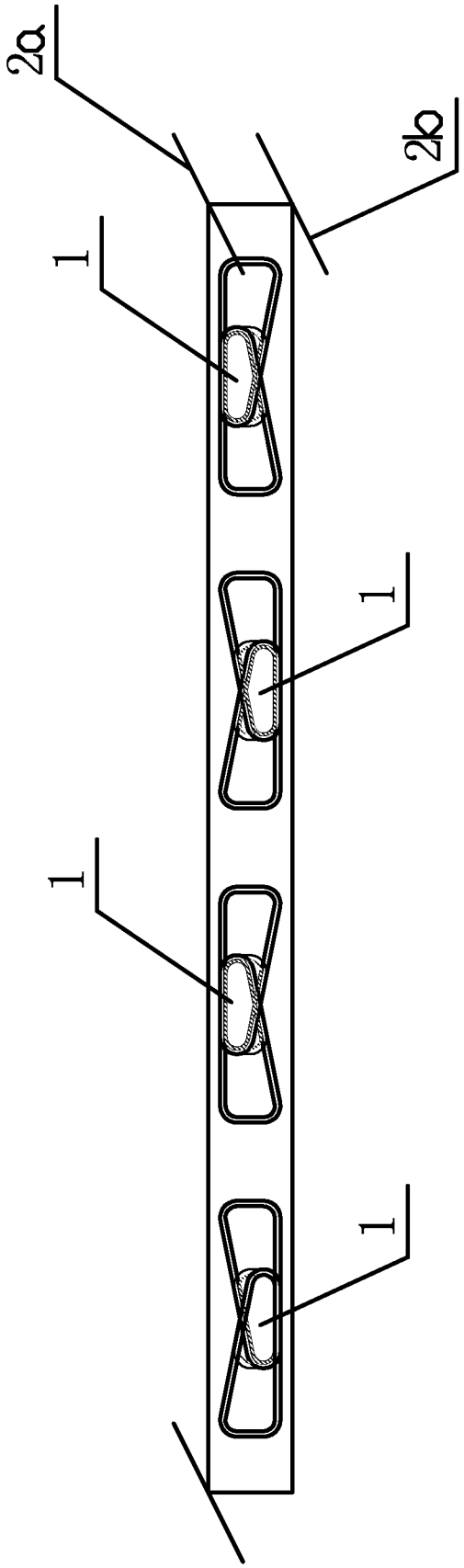


FIG. 27

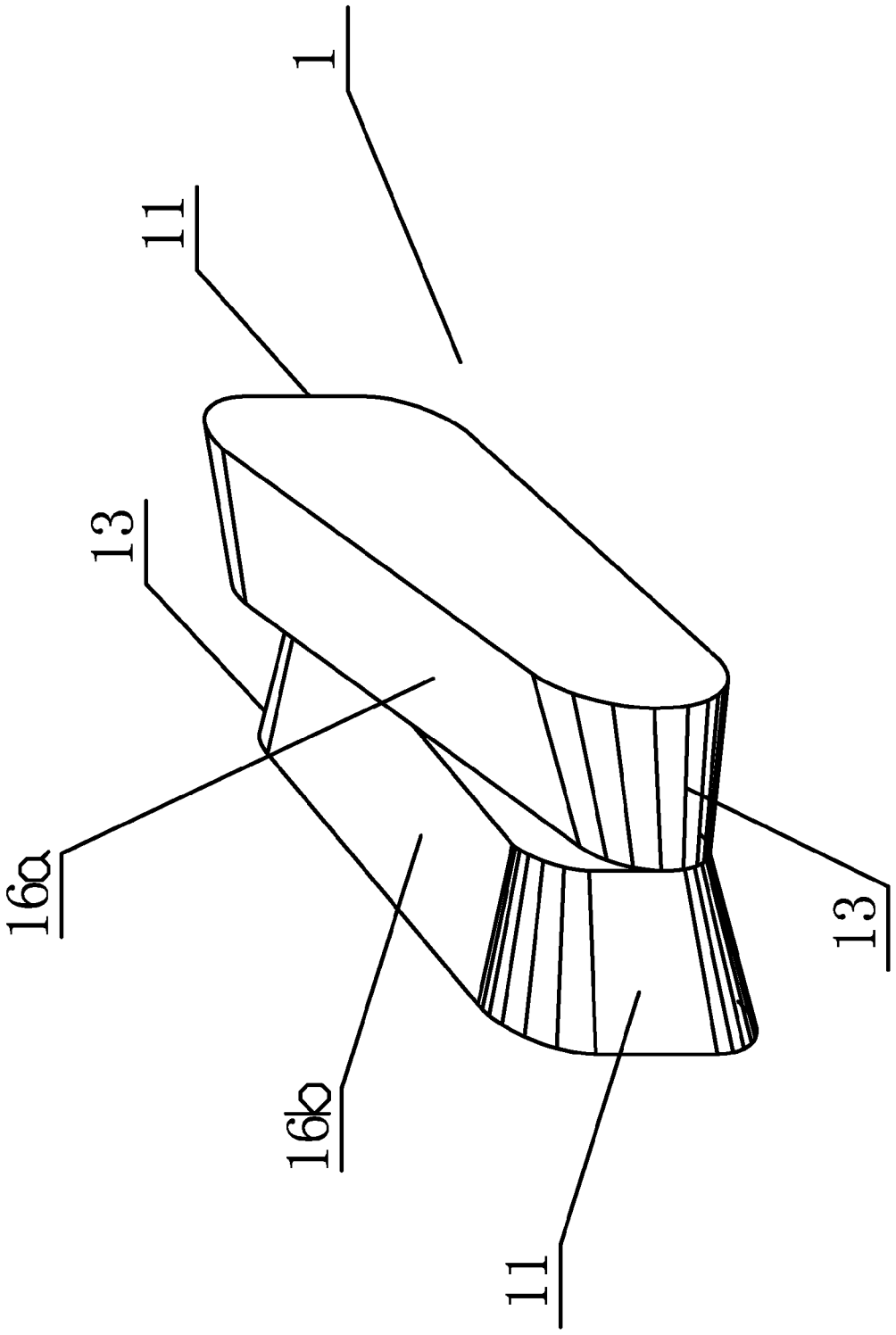
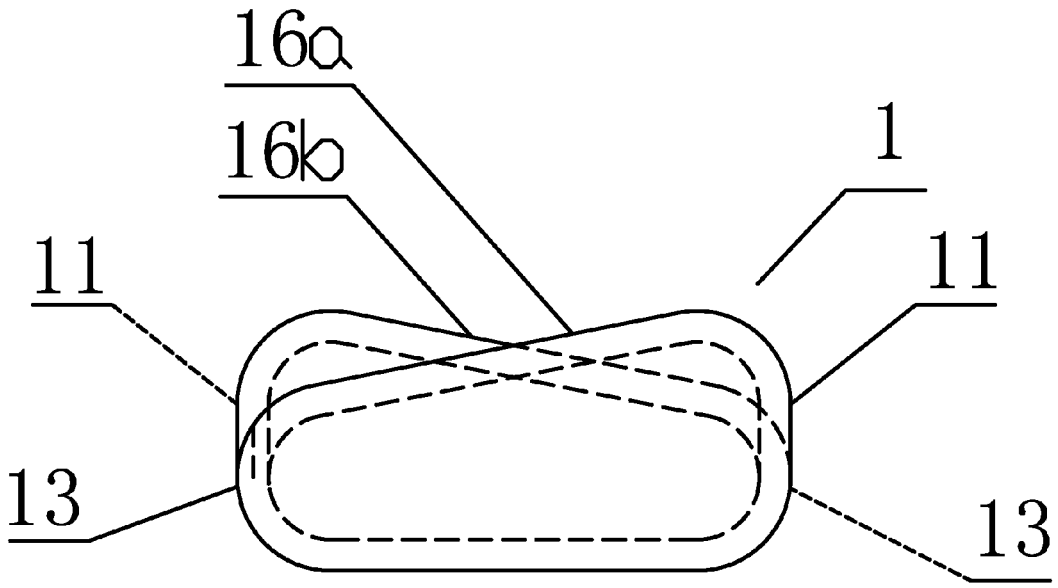


FIG. 28



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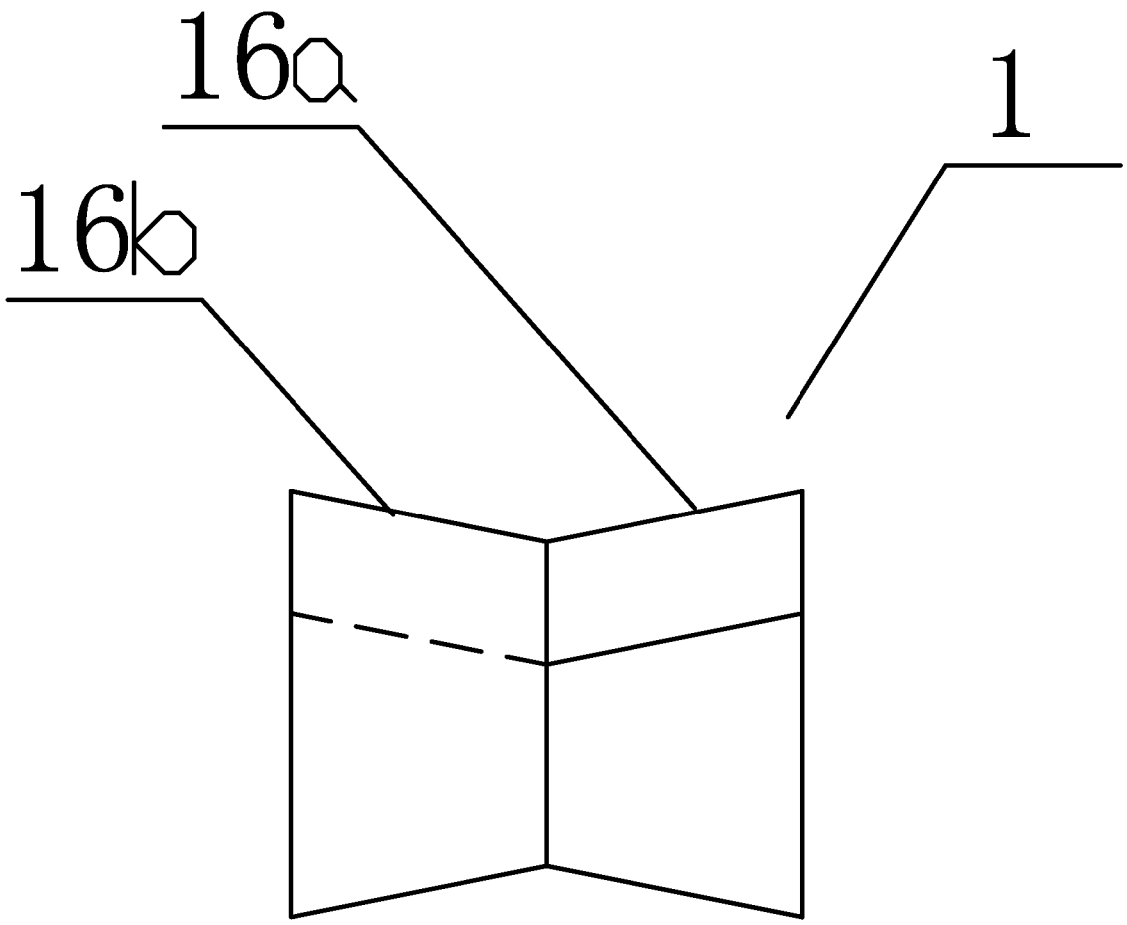


FIG. 30

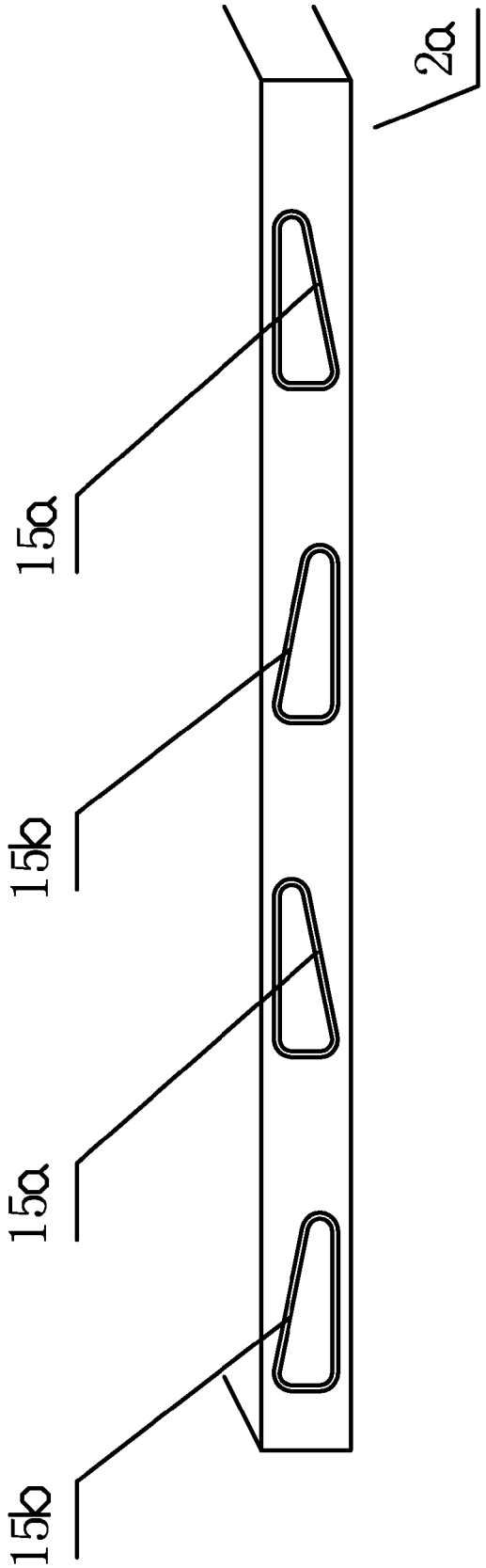
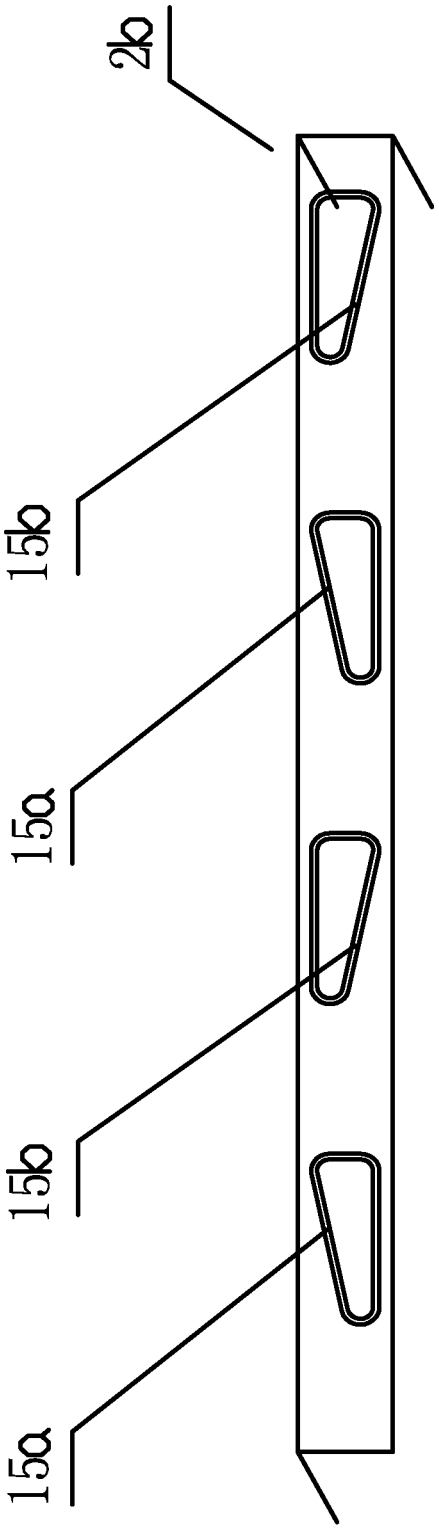


FIG. 31



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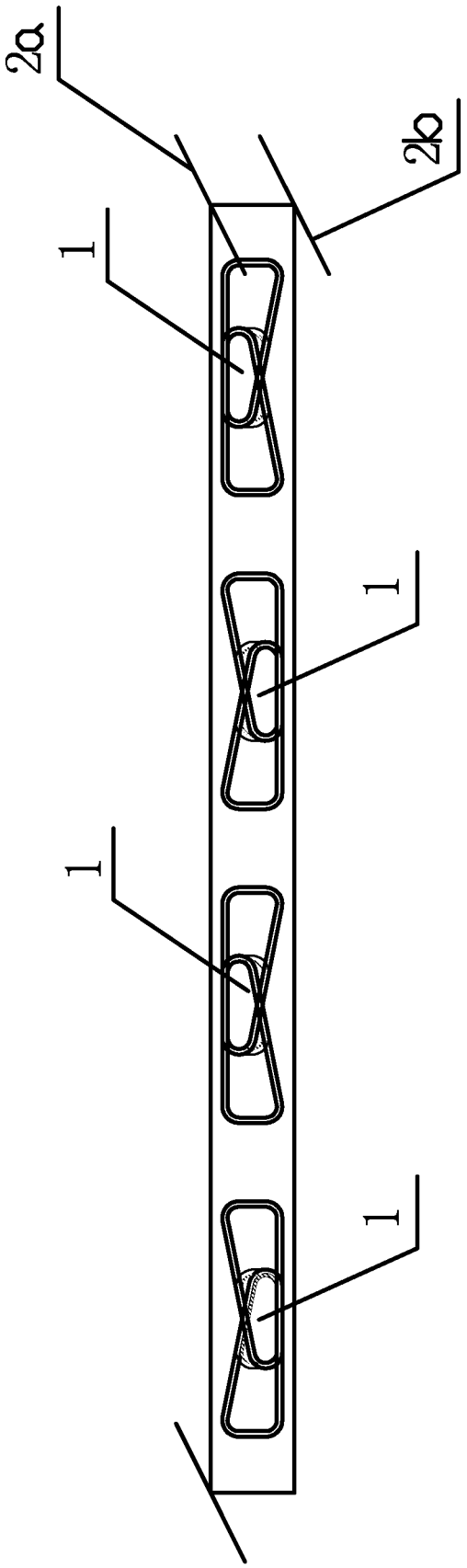

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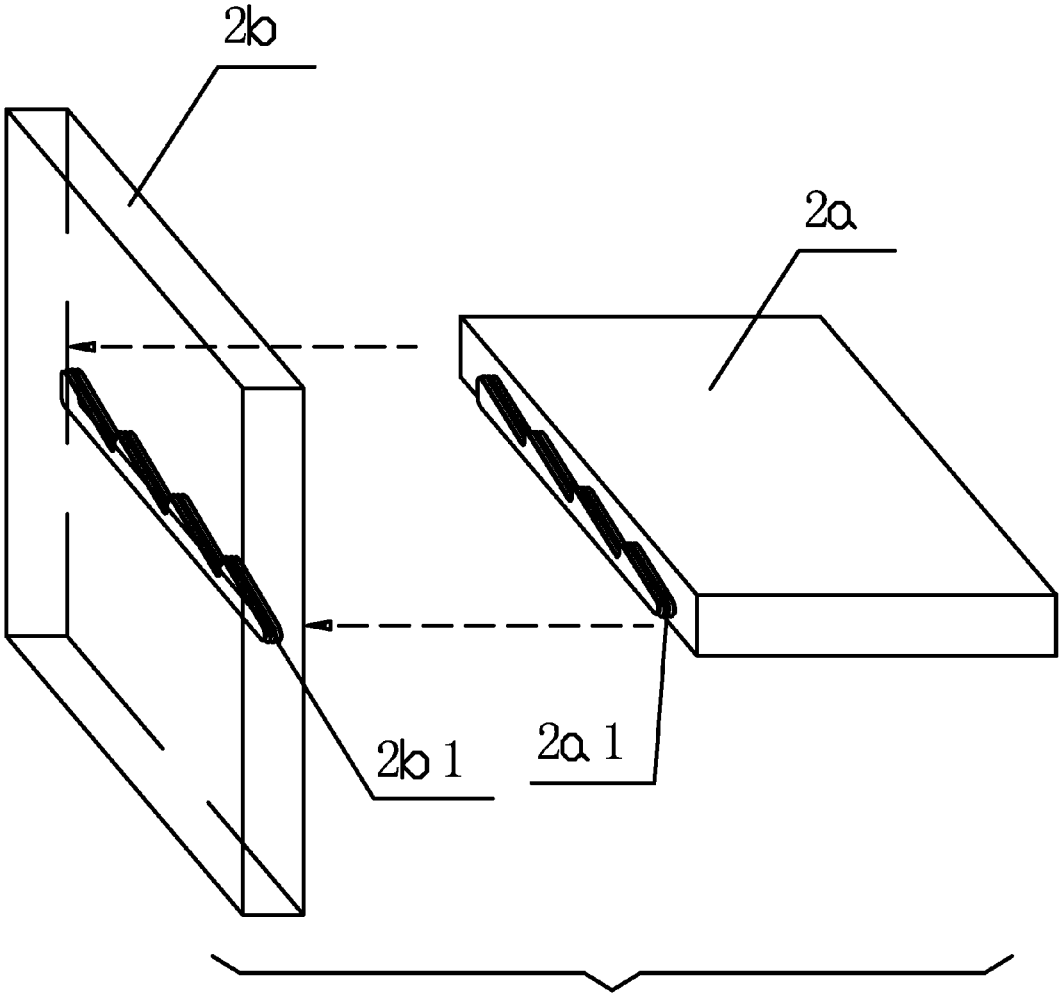

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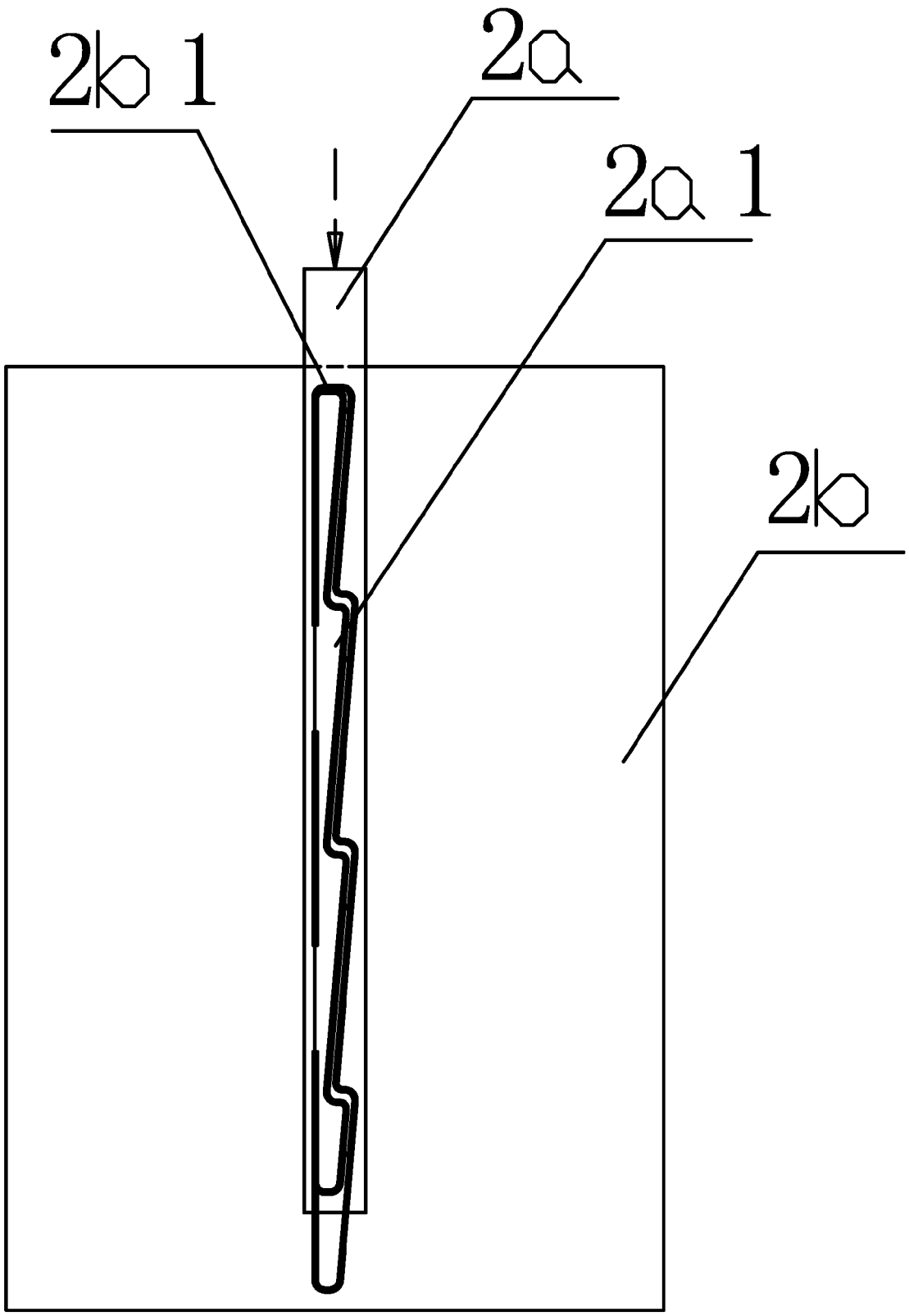

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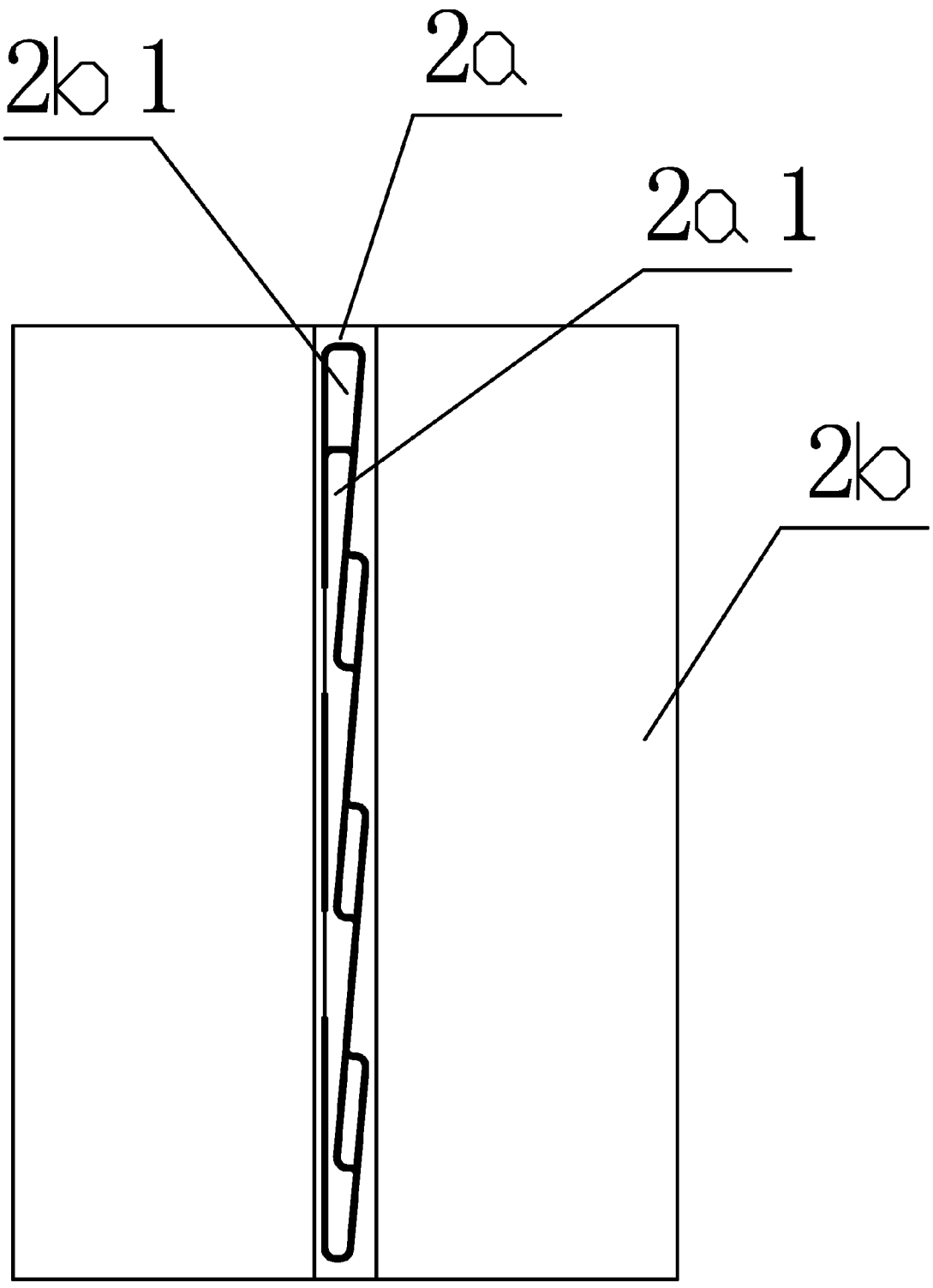

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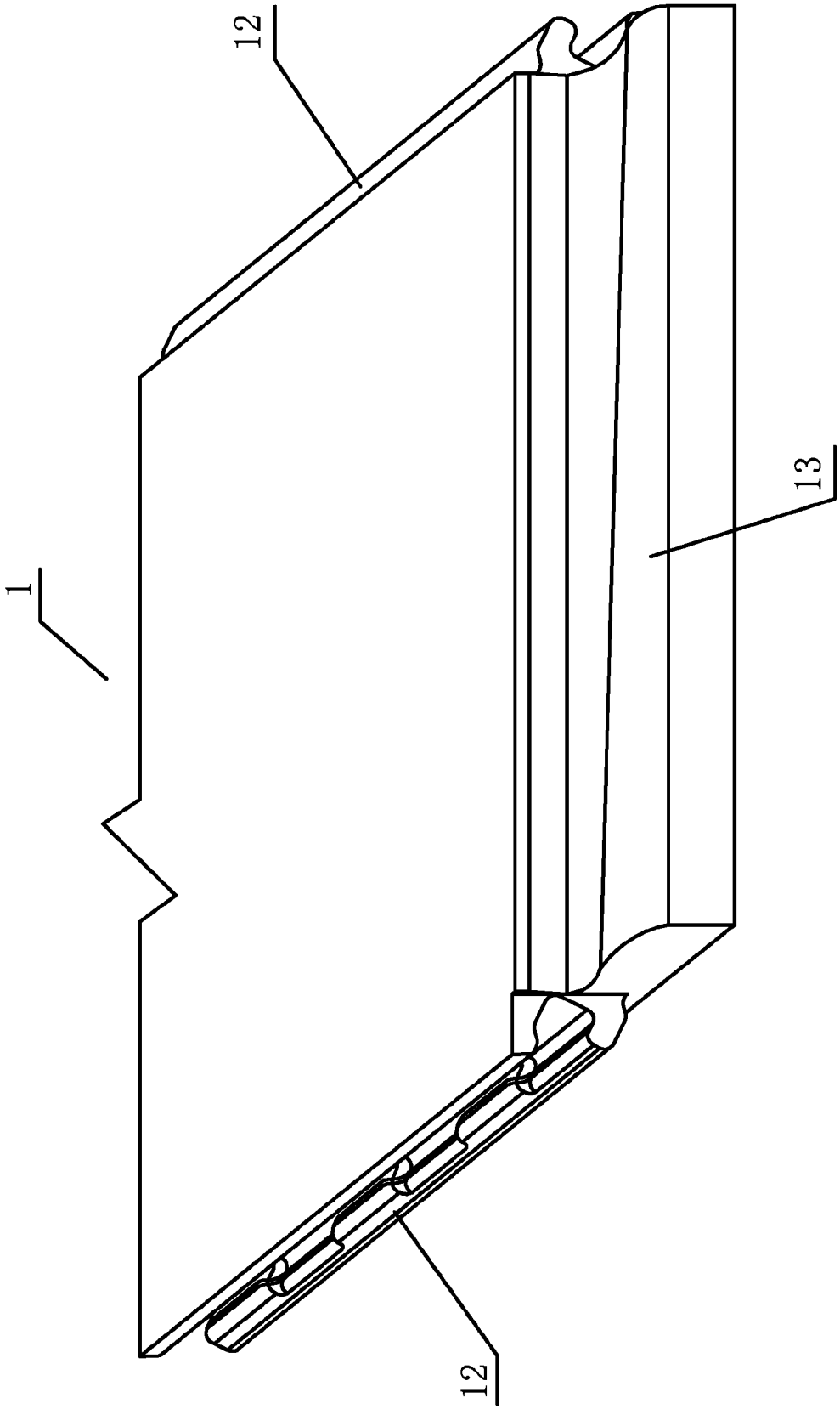

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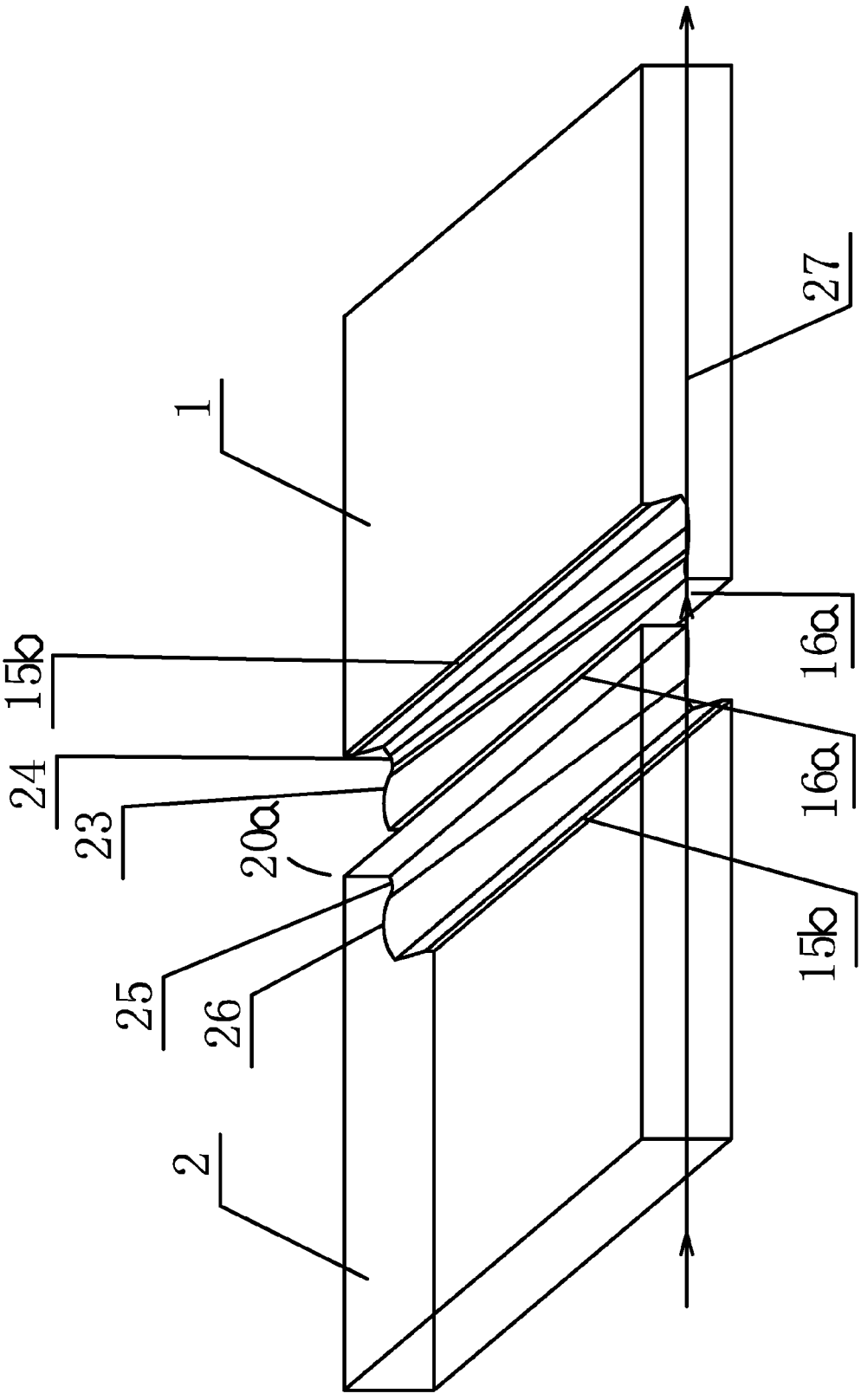

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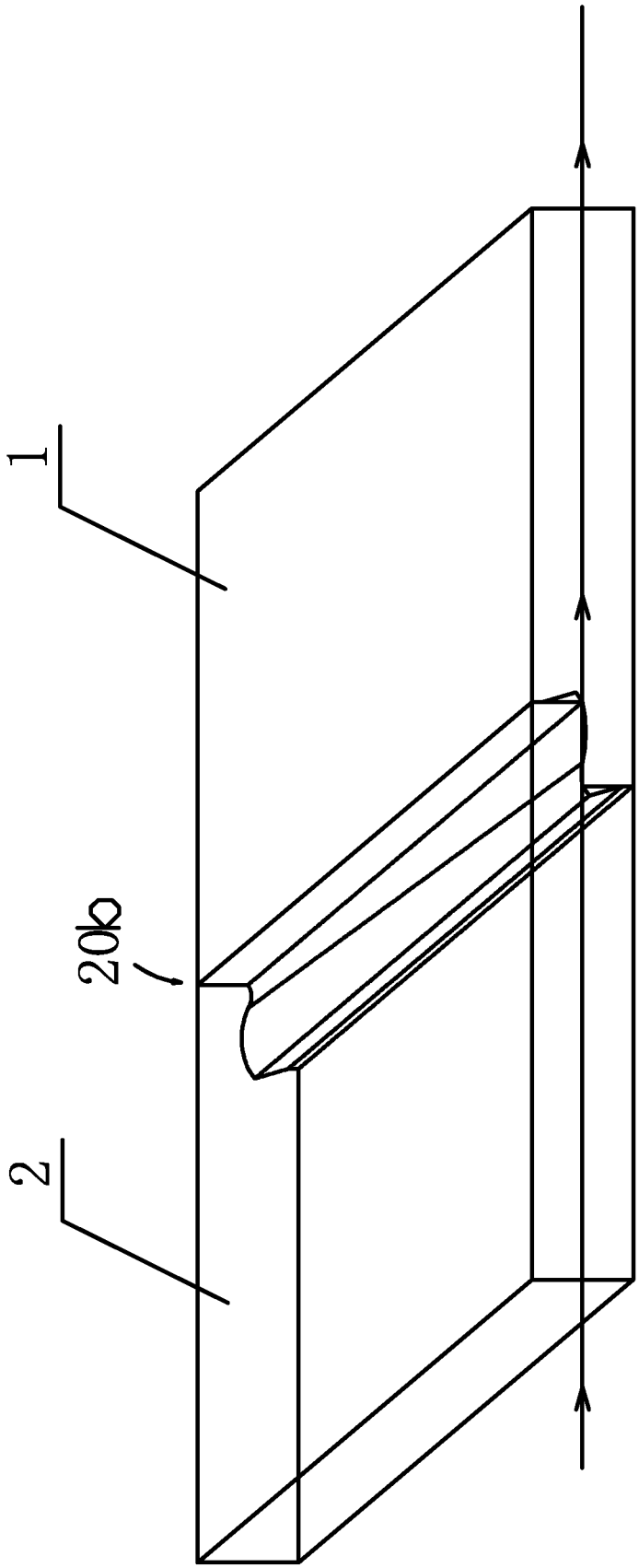

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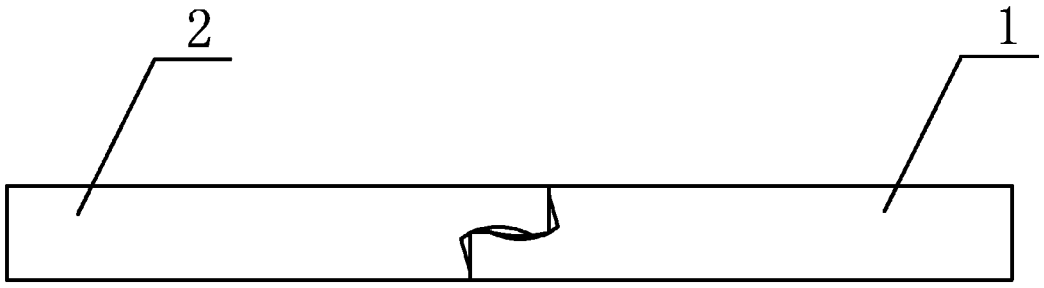

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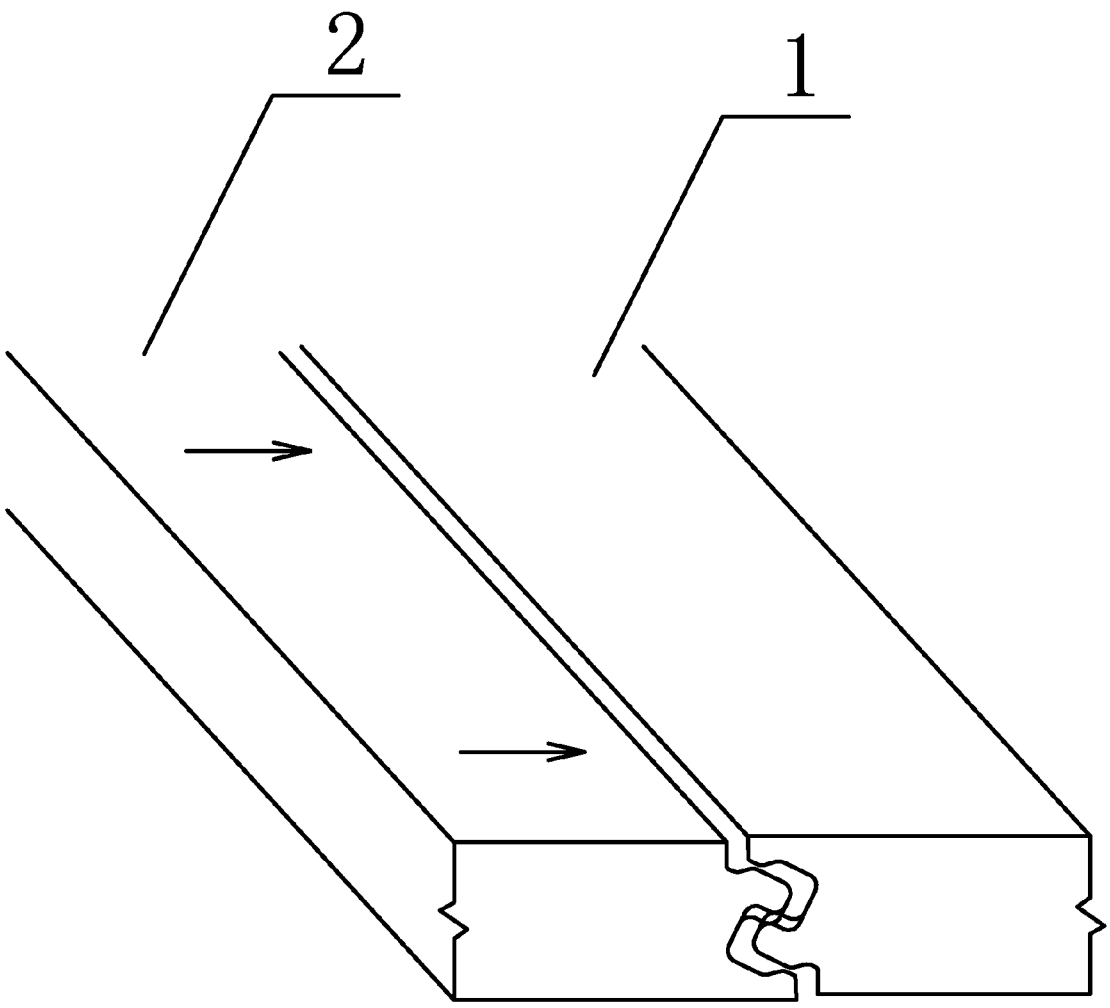

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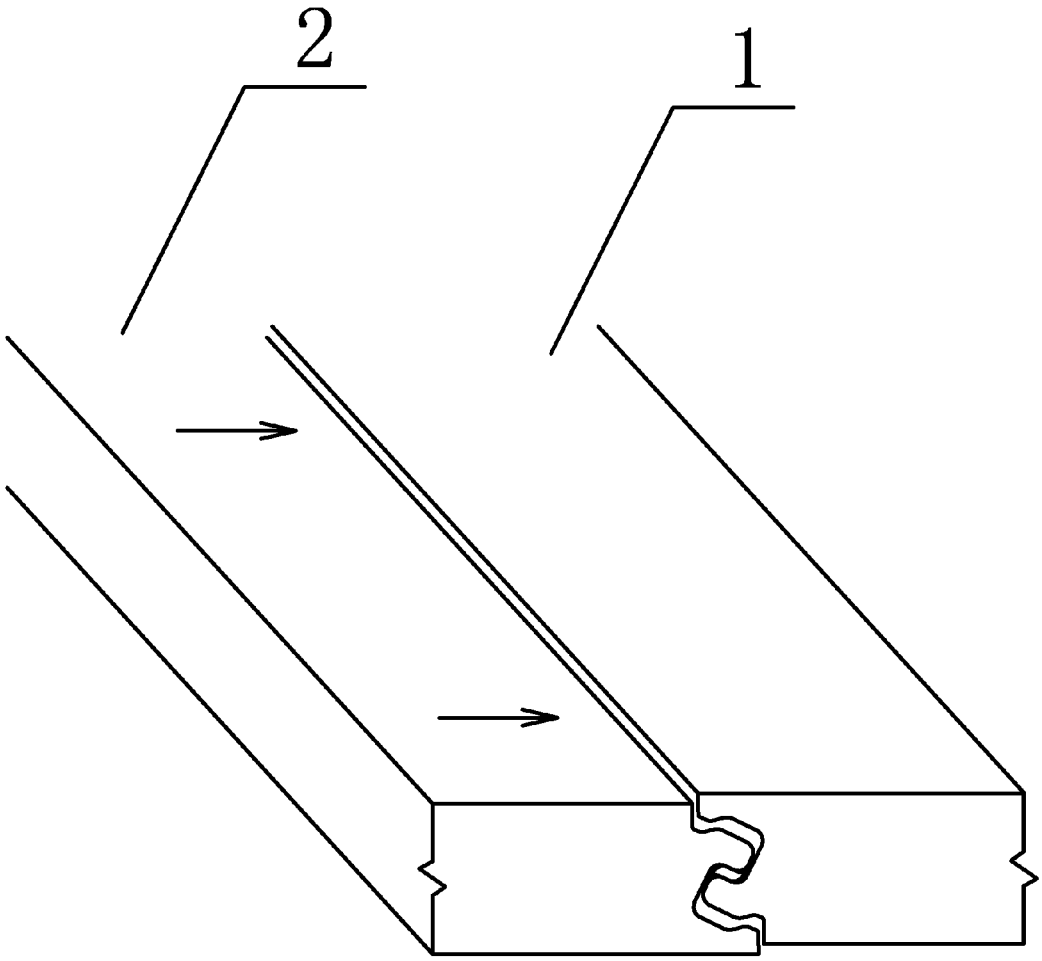

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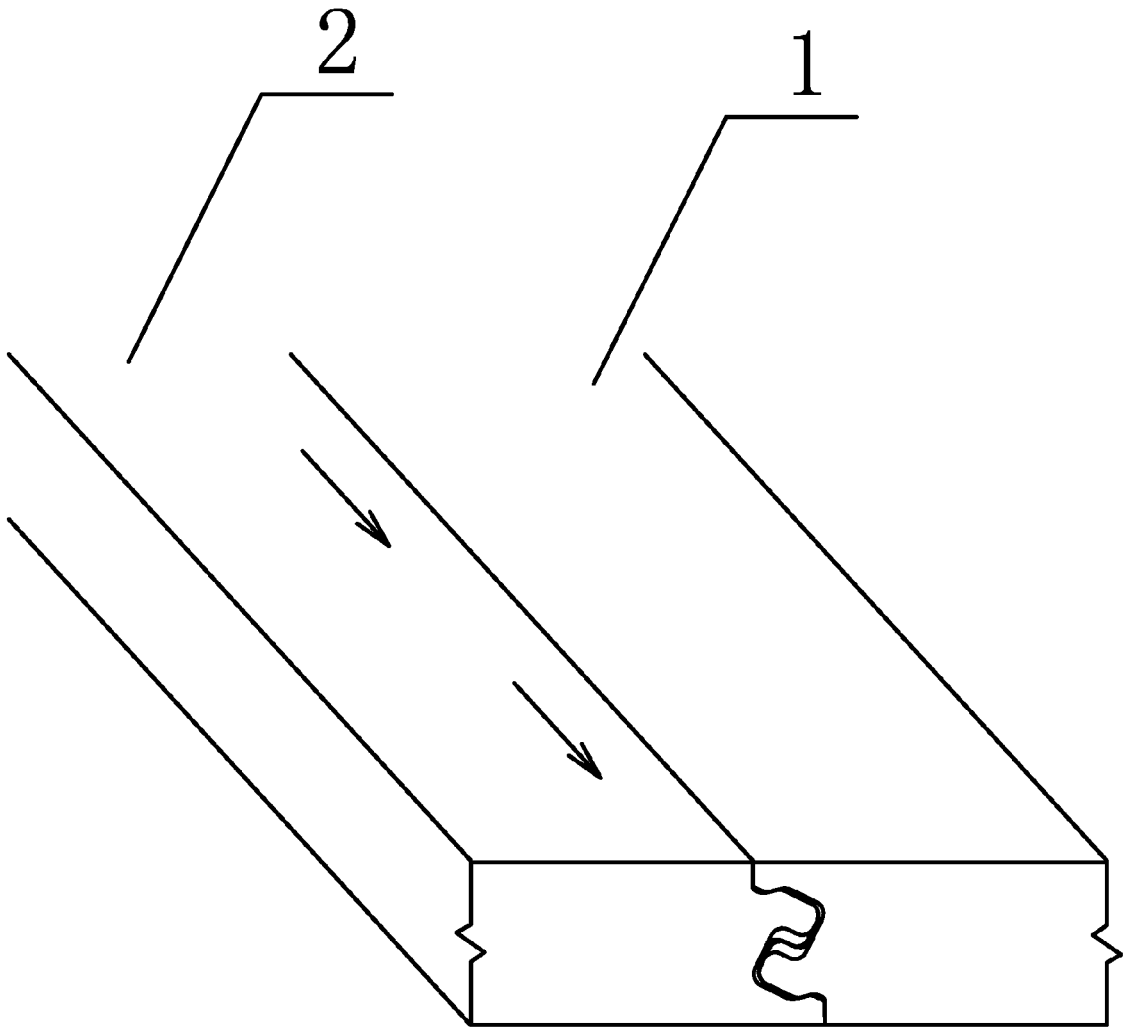

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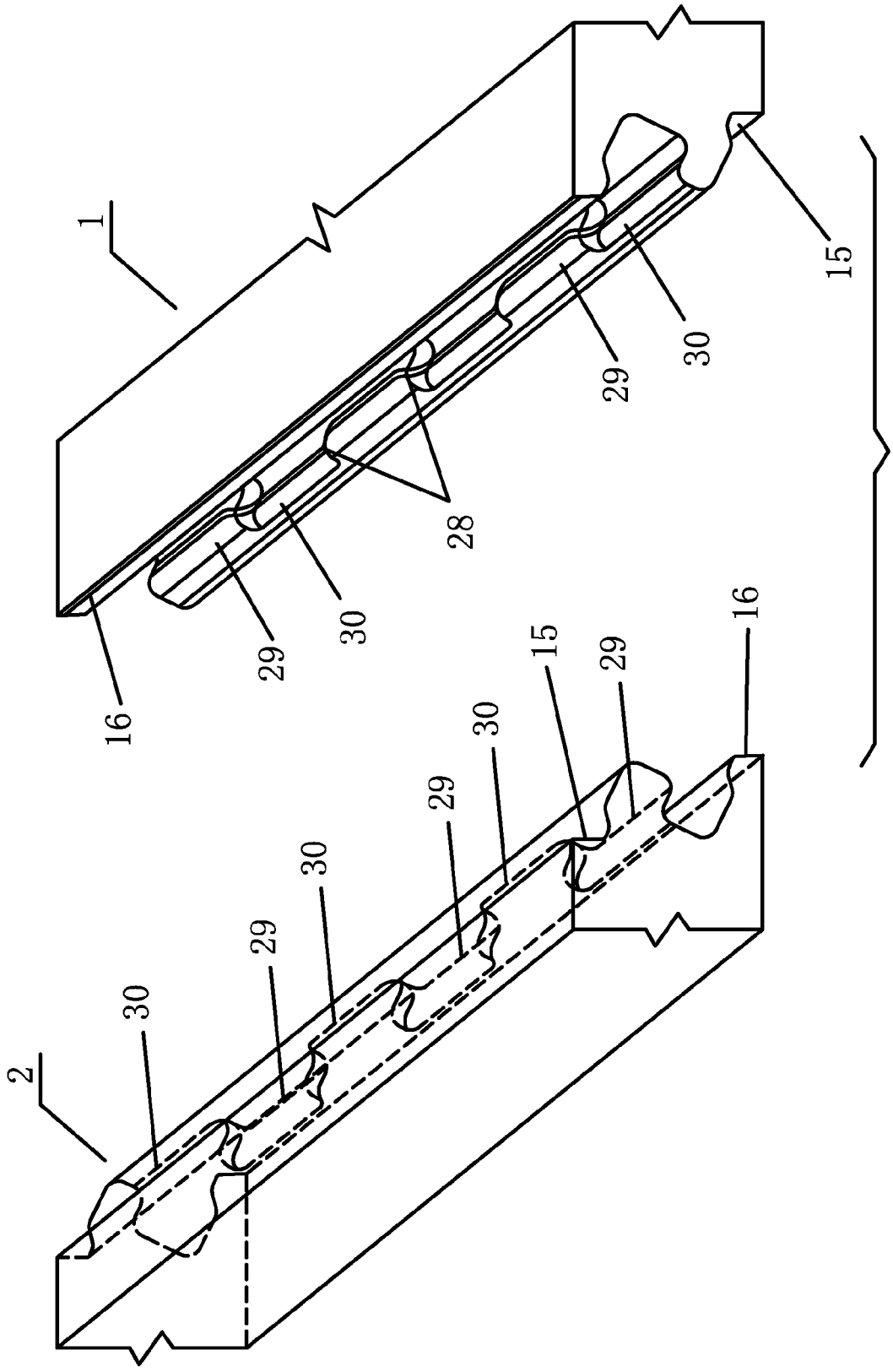

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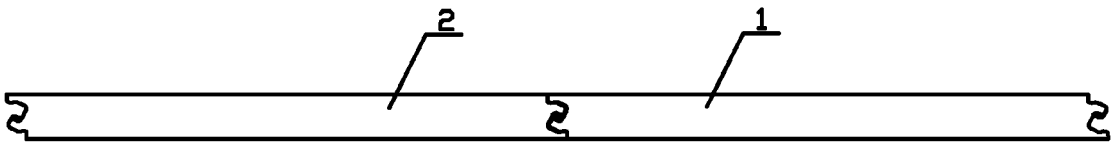

FIG. 45

FIG. 46

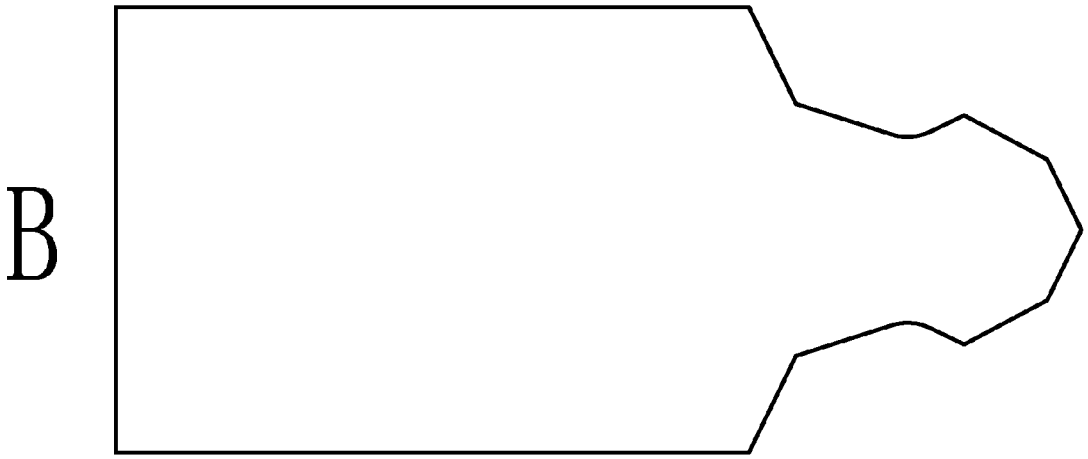

FIG. 47

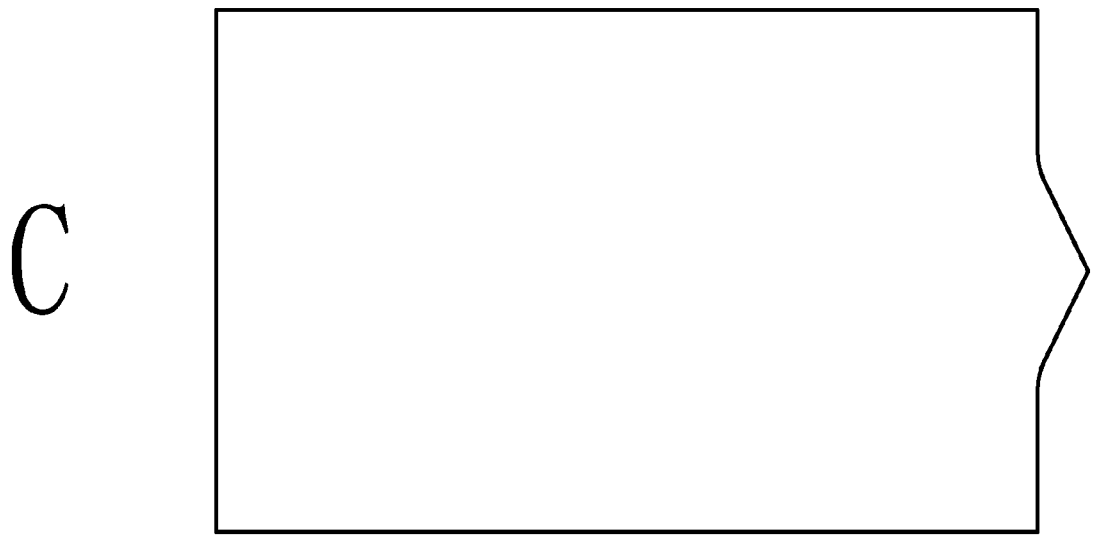

FIG. 48

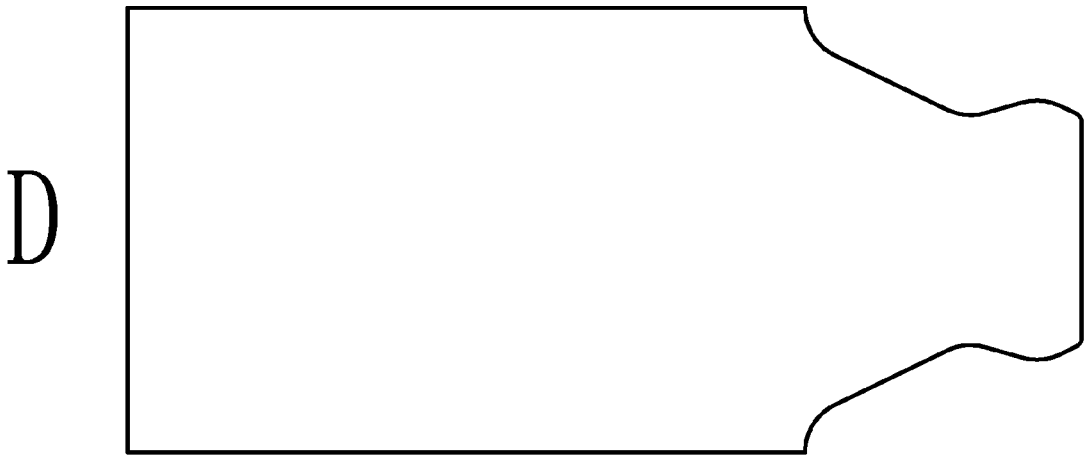

FIG. 49

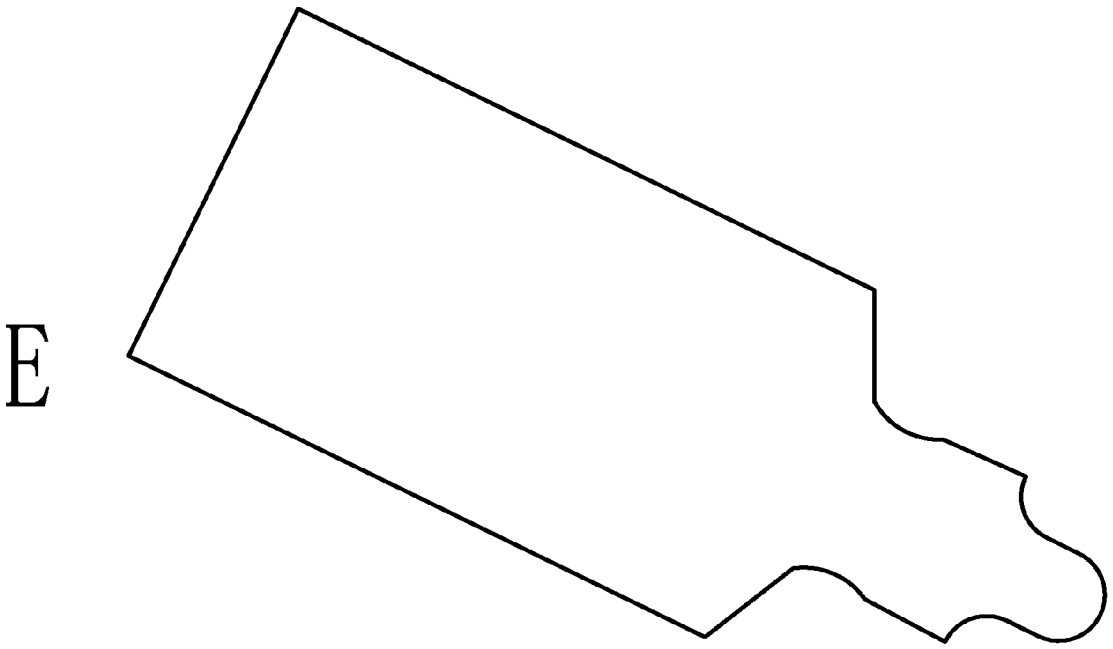

FIG. 50

FIG. 51

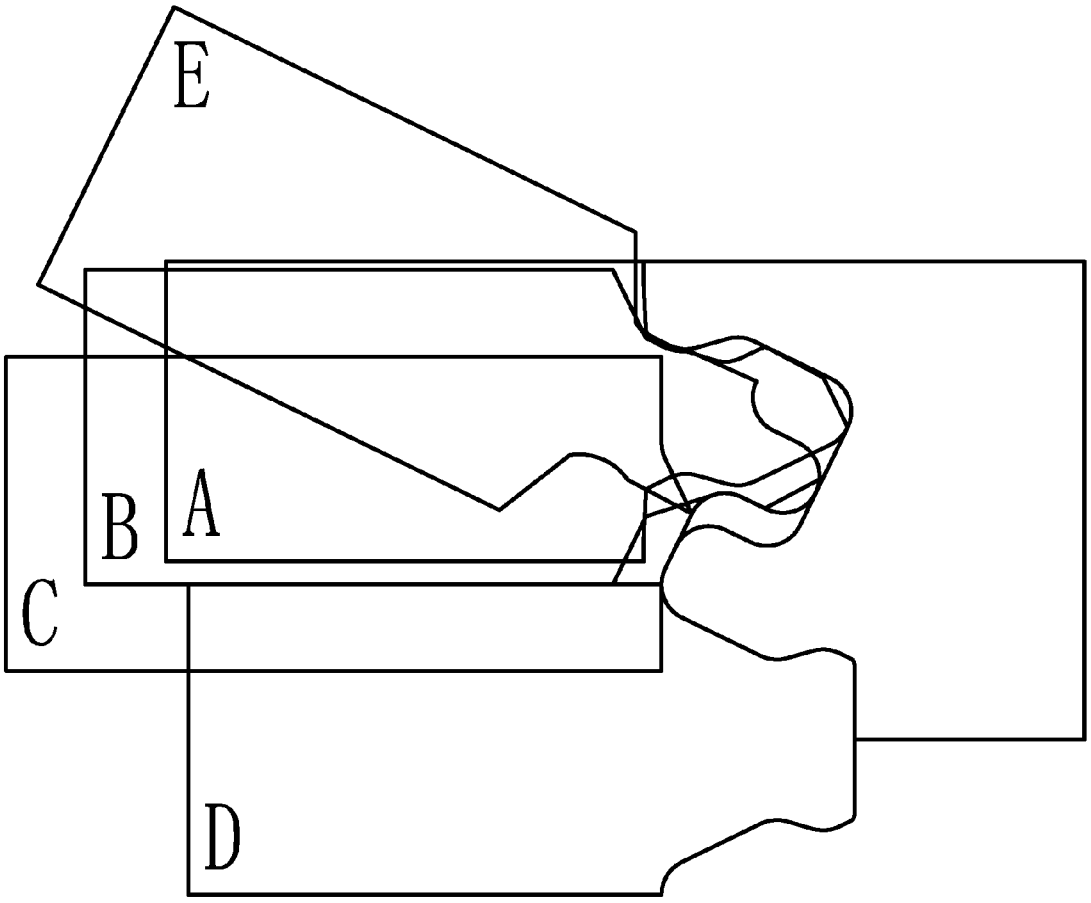

FIG. 52

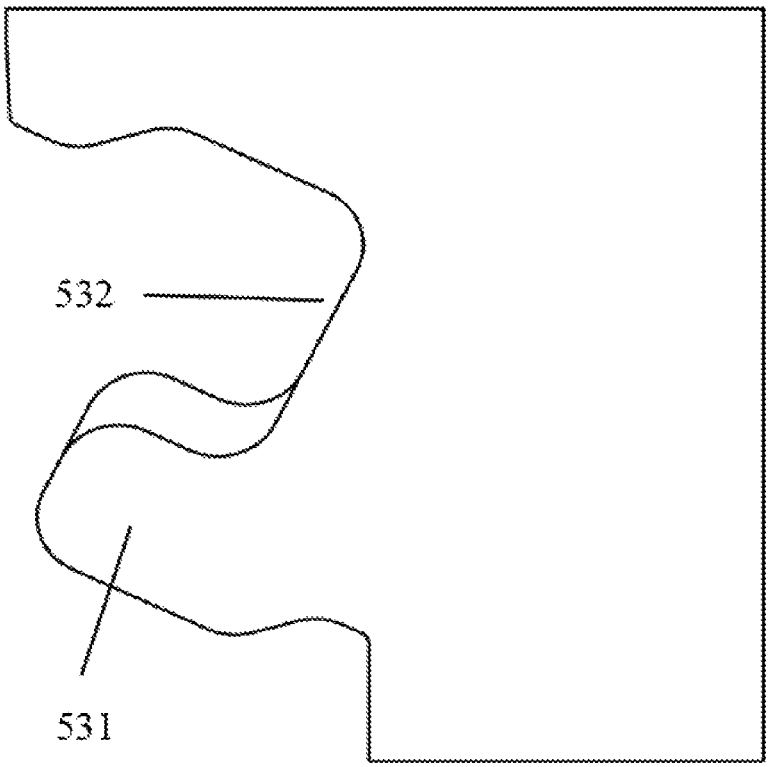

FIG. 53

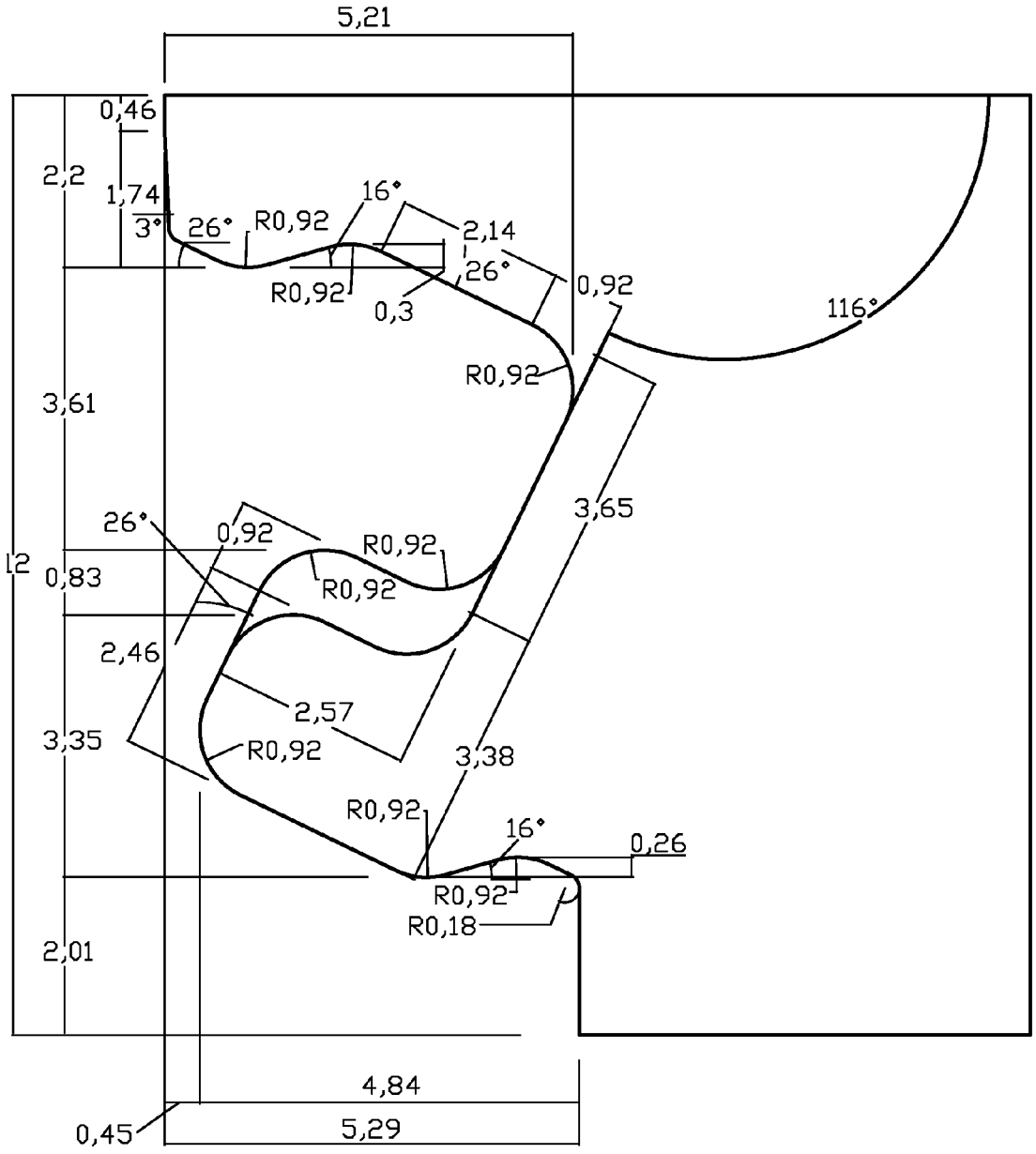
5,21
0,46
2,2
1,74
3°
26°
R0,92
16°
2,14
26°
0,92
R0,92
0,3
116°
R0,92
3,61
3,65
26°
0,92
R0,92
12
0,83
R0,92
2,46
2,57
3,35
R0,92
3,38
R0,92
16°
0,26
R0,92
R0,18
2,01
4,84
0,45
5,29

FIG. 54

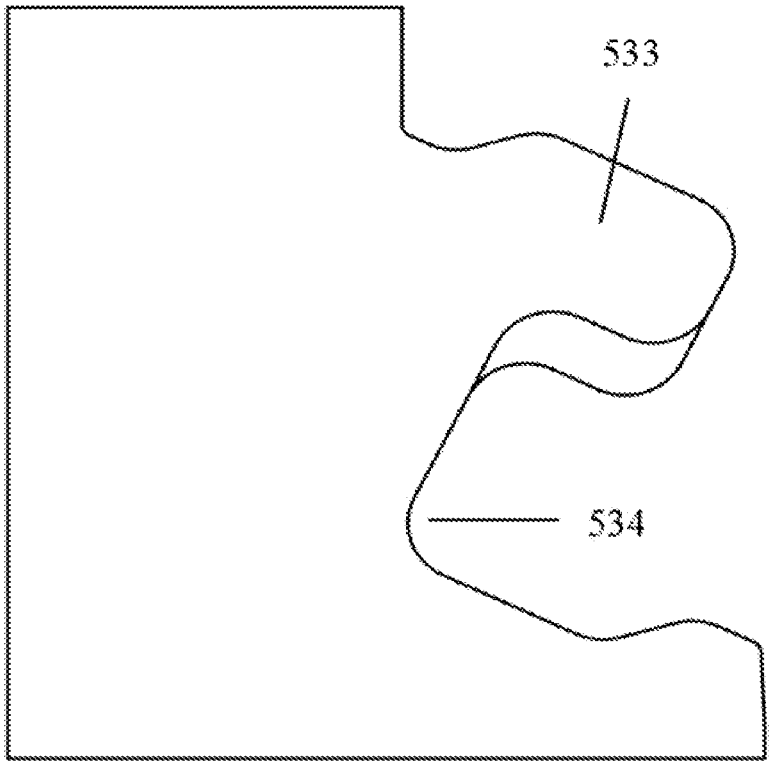

FIG. 55

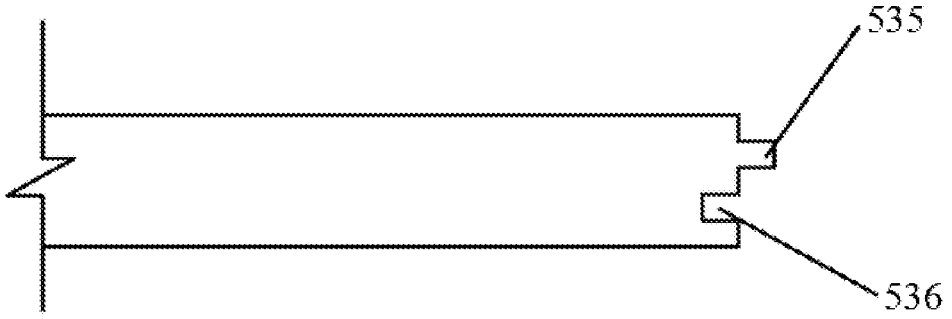

FIG. 56

FIG. 57

JOINT STRUCTURE FOR ASSEMBLING FLOORBOARDS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of International Patent Application No. PCT/CN2011/002131 with an international filing date of Dec. 19, 2011, designating the United States, now pending, and further claims priority benefits to Chinese Patent Application No. 201110035241.6 filed Jan. 29, 2011. The contents of all of the aforementioned applications, including any intervening amendments thereto, are incorporated herein by reference. Inquiries from the public to applicants or assignees concerning this document or the related applications should be directed to: Matthias Scholl P. C., Attn.: Dr. Matthias Scholl Esq., 14781 Memorial Drive, Suite 1319, Houston, Tex. 77079.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to the field of building materials, and more particularly to a joint structure for assembling wood floorboards or composite floorboards.

2. Description of the Related Art

Typical joints used in floorboards include: a round tenon and round mortise joint, and a rectangular tenon and rectangular mortise joint. Assembly process of the round tenon and round mortise joint includes: rotating the round tenon to place the round tenon in the round mortise, placing the floorboards to a horizontal level so as to interlock the round tenon and the round mortise. The round tenon and round mortise joint is sealed and water-proof on a surface of the stitching line, however, seams cannot be sealed if errors occurs, and a base of the assembled joint is not water-proof or damp-proof. Assembly process of the rectangular tenon and rectangular mortise joint includes: inserting pins obliquely downwards from the rectangular mortise to fix a floorboard, and leaving an expansion joint for inserting a mounting piece. The assembly process for the rectangular tenon and rectangular mortise joint has tremendous and complicated procedures, but low assembly efficiency. Besides, the assembled floorboards cannot be recycled after being disassembled, so that the rectangular tenon and rectangular mortise joint tends to be discarded.

SUMMARY OF THE INVENTION

In view of the above-described problems, it is one objective of the invention to provide a joint structure for a floorboard that has simple assembly, rigid connection, and high strength, and is water-proof and damp-proof in top and bottom surfaces of the joint.

To achieve the above objective, in accordance with one embodiment of the invention, there is provided a joint structure for a floorboard. The joint structure for a floorboard comprises: at least one first beveled tenon, the first beveled tenon comprising a tenon face facing upwards; a first beveled mortise, the first beveled mortise comprising a mortise face facing upwards; at least one second beveled tenon, the second beveled tenon comprising a tenon face facing downwards; and a second beveled mortise, the second beveled mortise comprising a mortise face facing downwards. The first beveled tenon is disposed in parallel to a surface of the floorboard at a right edge approximately half a height of the floorboard; the first beveled mortise is disposed at an inner side of the first beveled tenon. The second beveled tenon is disposed at a left edge approximately half the height of the floorboard. The second beveled mortise is disposed at an inner side of the second beveled tenon. The first beveled tenon matches with the second beveled mortise. The second beveled tenon matches with the first beveled mortise. An outer side of the first beveled tenon and an inner side of the second beveled mortise form a first interlock mechanism. An outer side of the second beveled tenon and an inner side of the first beveled mortise form a second interlock mechanism. In assembling, the first beveled tenon and the first beveled mortise of a first floorboard match with the second beveled mortise and the second beveled tenon of a second floorboard, respectively; and the two floorboards are further interlocked by the first interlock mechanism and the second interlock mechanism.

In accordance with another embodiment of the invention, there is provided with a joint structure for a floorboard, comprising: at least one first beveled tenon, the first beveled tenon comprising a tenon face facing outwards; a first beveled mortise, the first beveled mortise comprising a mortise face facing outwards; at least one second beveled tenon, the second beveled tenon comprising a tenon face facing outwards; and a second beveled mortise, the second beveled mortise comprising a mortise face facing outwards. The first beveled tenon is disposed in perpendicularity to a surface of the floorboard at a right edge approximately half a height of the floorboard. The first beveled mortise is disposed at an inner side of the first beveled tenon. The second beveled tenon is disposed at a left edge approximately half the height of the floorboard. The second beveled mortise is disposed at an inner side of the second beveled tenon. The first beveled tenon matches with the second beveled mortise. The second beveled tenon matches with the first beveled mortise. An outer side of the first beveled tenon and an inner side of the second beveled mortise form a first interlock mechanism. An outer side of the second beveled tenon and an inner side of the first beveled mortise form a second interlock mechanism. In assembling, the first beveled tenon and the first beveled mortise of a first floorboard match with the second beveled mortise and the second beveled tenon of a second floorboard, respectively; and the two floorboards are further interlocked by the first interlock mechanism and the second interlock mechanism.

In accordance with still another embodiment of the invention, there is provided with a joint structure for a floorboard, comprising: at least one first curved tenon, the first curved tenon comprising a tenon face facing outwards; a first curved mortise, the first curved mortise comprising a mortise face facing outwards; at least one second curved tenon, the second curved tenon comprising a tenon face facing outwards; and a second curved mortise, the second curved mortise comprising a mortise face facing outwards. The first curved tenon is disposed inclined to a surface of the floorboard at a right edge approximately half a height of the floorboard. The first curved mortise is disposed at an inner side of the first curved tenon. The second curved tenon is disposed at a left edge approximately half the height of the floorboard. The second curved mortise is disposed at an inner side of the second curved tenon. The first curved tenon matches with the second curved mortise. The second curved tenon matches with the first curved mortise. An outer side of the first curved tenon and an inner side of the second curved mortise form a first interlock mechanism. An outer side of the second curved tenon and an inner side of the first curved mortise form a second interlock mechanism. In assembling, the first curved tenon and the first curved mortise of a first floorboard match with the second curved mortise and the second curved tenon of a second

floorboard, respectively; and the two floorboards are further interlocked by the first interlock mechanism and the second interlock mechanism.

In a class of this embodiment, the second interlock mechanism is formed by arranging tooth-shaped tenons respectively on the inner side of the first beveled mortise and the outer side of the second beveled tenon, allowing a tooth top line and a tooth bottom line of each of the tooth-shaped tenons to be in parallel with the surface of the floorboard, and engaging the two tooth-shaped tenons with each other. The first interlock mechanism is formed by arranging tooth-shaped tenons respectively on the outer side of the first beveled tenon and the inner side of the second beveled mortise, allowing a tooth top line and a tooth bottom line of each of the tooth-shaped tenons to be in parallel with the surface of the floorboard, and engaging the two tooth-shaped tenons with each other.

In a class of this embodiment, the second interlock mechanism is formed by arranging a trapezoidal blind mortise on the inner side of the first beveled mortise and a trapezoidal tenon on the outer side of the second beveled tenon, respectively, and matching the trapezoidal blind mortise and the trapezoidal tenon with each other. The first interlock mechanism is formed by arranging the trapezoidal tenon on the outer side of the first beveled tenon and a trapezoidal blind mortise on the inner side of the second beveled mortise, respectively, and matching the trapezoidal blind mortise and the trapezoidal tenon with each other.

In a class of this embodiment, a deformation structures is formed between the trapezoidal tenon arranged on the outer side of either the first tenon or the second tenon, and corresponding edge of the floorboard. The deformation structure comprises: a triangular ridge comprising a sharp edge, or a rectangular ridge comprising a sharp edge. The sharp edge leans against a beveled line of the trapezoidal blind mortise so as to form a line contact. An expansion joint is formed between the other two sides of the triangular ridge or the other three sides of the rectangular ridge for avoiding contact.

Because the expansion joint is designed, it is not required to insert a sandwich piece, thereby saving the assembly time. Besides, the beveled tenon-and-mortise joint provides the floorboard with a highly integrative structure, so that the fixation by inserting pins are avoided, which further saving the time and the production cost. The deformation structure is designed for solving problems resulting from the natural expansion of the floorboard.

The interlock mechanism is not limited to the above structures, it is a structure comprising a rectangular tenon and a rectangular blind mortise, or a structure comprising a miter tenon and a rectangular corner.

In a class of this embodiment, the floorboard comprises: a front edge comprising a straight tenon on an upper part and a straight blind mortise on a lower part; and a rear edge comprising a straight blind mortise on an upper part and a straight tenon on a lower part.

In the process of assembling the floorboards, dovetail tenon-and-mortise joint are added on two ends that are intersected with the ends provided with the beveled tenon-and-mortise joint so as to increase the strength in a direction in perpendicularity to a grain. Dovetail mortises are arranged on the upper part and the lower part of each of the front edge and the rear edge of the first floorboard and the second floorboard; and each of the dovetail mortise is provided with the dovetail tenon strip.

In a class of this embodiment, beveled tenons of the first floorboard and the second floorboard have the same slope on the same side. One or more beveled tenon-and-mortise joints are provided.

To assemble floorboards employing the joint structure and using the tooth-shaped tenon or the trapezoidal tenon-and-blind mortise as the interlock mechanism, place the beveled tenon of the first floorboard in the beveled mortise of the second floorboard, push the beveled tenon from a relatively wide beveled mortise to a relatively narrower beveled mortise so as to fix the beveled tenon inside the beveled mortise; meanwhile, further interlock the two floorboards by the interlock mechanism of the he tooth-shaped tenon or the interlock mechanism of the trapezoidal tenon-and-blind mortise so as to effectively prevent the boards from splitting in the joint part. Because the base of the joint part overlaps with one another, the base is damp-proof. Floorboards of such structure are capable of forming a rigid integrative structure and preventing the floorboards from falling apart. The up-down connected part is sealed, thereby being damp-proof. No swell and few contraction of the floorboard will happen after long term use. The joint has a simple structure, convenient assembly, which is very suitable for assembling wood floorboards and composite floorboards.

Advantages of the invention are as follows:

1) when used in decorative wall panels, the assembly process using the joint structure is simple and time saving; the assembled decorative wall panels has completely sealed stitching lines, high integration, no nail holes or exposed screws, and seam splitting resulting from retraction of the floorboard is prevented.
2) when used in light weight building walls, the use of the joint structure is capable of saving a large amount of keels for fixing internal joints.
3) when used in water proof wall panels used in wooden building. The joint structure of the invention is capable of largely increasing the air impermeability (energy saving) and the strength of the integrative structure (wind resistant and shock resistant).
4) A paint treatment on the joint position can prevent the formation of the joint splitting.
5) The use of the joint of the invention is suitable to cut panels of large area into small pieces so as to save packing materials and the transporting space, which meets the requirements of environmental protection.
6) The joint structure of the invention decreases the use of the pins and assembly process thereof, and meanwhile the gluing is saved.
7) When the joint structure is used in furniture, the use of the hardware and glue can be largely decreased. The integrative structure is transformed from a conventional point stress structure into a line stress structure, thereby improving the duration of the whole furniture, omitting the gluing process, simplifying the assembly and disassembly, and meeting the requirements of environmental protection.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described hereinbelow with reference to the accompanying drawings, in which:

FIG. **1** is a structure diagram of a floorboard comprising a tenon- and mortise joint in accordance with one embodiment of the invention;

FIG. **2** is a structure diagram of a floorboard comprising a tenon- and mortise joint in accordance with one embodiment of the invention;

FIG. **3** is an axonometric drawing of hardwood floorboards comprising a plurality of beveled tenon-and-mortise joints in accordance with one embodiment of the invention;

FIG. **4** is an enlarged view of a deformation structure of assembled hardwood floorboards of FIG. **3** in accordance with one embodiment of the invention;

FIG. **5** is an axonometric drawing of softwood floorboards comprising a plurality of beveled tenon-and-mortise joints in accordance with one embodiment of the invention;

FIG. **6** is an enlarged view of a deformation structure of assembled softwood floorboards of FIG. **5** in accordance with one embodiment of the invention;

FIG. **7** is an axonometric drawing of two floorboards to be assembled in accordance with one embodiment of the invention;

FIG. **8** is a laterally sectional view of two floorboards to be assembled in accordance with one embodiment of the invention;

FIG. **9** is a cross sectional view of a floorboard end comprising a lower straight tenon and an upper straight mortise in accordance with one embodiment of the invention;

FIG. **10** is a cross sectional view of a floorboard end comprising a lower straight mortise and an upper straight tenon in accordance with one embodiment of the invention;

FIG. **11** is a laterally sectional view of two assembled floorboards in accordance with one embodiment of the invention;

FIG. **12** is a top view of a floorboard in accordance with one embodiment of the invention;

FIG. **13** is a top view of assembled floorboards in accordance with one embodiment of the invention;

FIG. **14** is an axonometric drawing of veneers comprising beveled tenon-and-mortise joints before assembly in accordance with one embodiment of the invention;

FIG. **15** is a structure diagram of planks comprising beveled tenon-and-mortise joints before assembly in accordance with one embodiment of the invention;

FIG. **16** is a structure diagram of planks comprising beveled tenon-and-mortise joints after assembly in accordance with one embodiment of the invention;

FIG. **17** is a top view of planks comprising beveled tenon-and-mortise joints after assembly in accordance with one embodiment of the invention;

FIG. **18** is a structure diagram of floorboards comprising beveled tenon-and-mortise joints in perpendicularity to the floorboards before assembly in accordance with one embodiment of the invention;

FIG. **19** is a structure diagram of floorboards comprising beveled tenon-and-mortise joints in perpendicularity to the floorboards after assembly in accordance with one embodiment of the invention;

FIG. **20** is a structure diagram of floorboards comprising beveled tenon-and-mortise joints at an angle of 45° to the floorboards before assembly in accordance with one embodiment of the invention;

FIG. **21** is a structure diagram of floorboards comprising beveled tenon-and-mortise joints at an angle of 45° to the floorboards before assembly in accordance with one embodiment of the invention;

FIG. **22** is a structure diagram of a tooth-shaped tenon in accordance with one embodiment of the invention;

FIG. **23** is a front view of a tooth-shaped tenon of FIG. **1** in accordance with one embodiment of the invention;

FIG. **24** is a lateral view of a tooth-shaped tenon of FIG. **1** in accordance with one embodiment of the invention;

FIG. **25** is a structure diagram of a connecting member comprising a groove fitting with a tooth-shaped tenon in accordance with one embodiment of the invention;

FIG. **26** is a structure diagram of another connecting member comprising a groove fitting with a tooth-shaped tenon in accordance with one embodiment of the invention;

FIG. **27** is a structure diagram of connecting members of FIGS. **25-26** assembled by a tooth-shaped tenon of FIG. **22** in accordance with one embodiment of the invention;

FIG. **28** is a structure diagram of a dovetail beveled tenon in accordance with one embodiment of the invention;

FIG. **29** is a lateral view of a dovetail beveled tenon of FIG. **7** in accordance with one embodiment of the invention;

FIG. **30** is a front view of a dovetail beveled tenon of FIG. **7** in accordance with one embodiment of the invention;

FIG. **31** is a structure diagram of a connecting member comprising a groove fitting with a dovetail beveled tenon in accordance with one embodiment of the invention;

FIG. **32** is a structure diagram of another connecting member comprising a groove fitting with a dovetail beveled tenon in accordance with one embodiment of the invention;

FIG. **33** is a structure diagram of connecting members of FIGS. **31-32** assembled;

FIG. **34** is a an axonometric drawing of connecting members comprising a plurality of tenons and mortises before assembly in accordance with one embodiment of the invention;

FIG. **35** is a top view of two connecting members comprising reversed straight angle tenons in assembly in accordance with one embodiment of the invention;

FIG. **36** is a op view of two connecting members comprising reversed straight angle tenons in assembly in accordance with one embodiment of the invention;

FIG. **37** is a structure diagram of a floorboard combined with a curved tenon-and-mortise joint **12** and a tapered tenon-and-mortise joint **13** in accordance with one embodiment of the invention;

FIG. **38** is a structure diagram of floorboards comprising a tapered tenon-and-mortise joint before assembly in accordance with one embodiment of the invention;

FIG. **39** is a structure diagram of floorboards comprising a tapered tenon-and-mortise joint after assembly in accordance with one embodiment of the invention;

FIG. **40** is a cross section view of an assembled tapered tenon-and-mortise joint;

FIG. **41** is a first installation diagram of floorboards comprising a curved tenon-and-mortise joint in accordance with one embodiment of the invention;

FIG. **42** is a second installation diagram of floorboards comprising a curved tenon-and-mortise joint in accordance with one embodiment of the invention;

FIG. **43** is a second installation diagram of floorboards comprising a curved tenon-and-mortise joint in accordance with one embodiment of the invention;

FIG. **44** is a structure diagram of a curved tenon-and-mortise joint before assembly in accordance with one embodiment of the invention;

FIG. **45** is a cross section view of a curved tenon-and-mortise joint after assembly in accordance with one embodiment of the invention;

FIGS. **46-50** are structure diagrams of milling cutters of different shapes for machining a curved tenon-and-mortise joint; in accordance with one embodiment of the invention;

FIG. **51** is a machining path of a milling cutter of shape E in accordance with one embodiment of the invention;

FIG. **52** is a structure diagram of different milling cutters shaping different positions of a curved tenon-and-mortise joint in accordance with one embodiment of the invention;

FIG. **53** is a structure diagram of a part of a floorboard having at its one edge a curved tenon and a curved mortise in accordance with one embodiment of the invention;

FIG. **54** is a structure diagram of a curved tenon-and-mortise joint with specific dimensions in accordance with one embodiment of the invention.

FIG. **55** is a structural diagram of another part of the floorboard of FIG. **53** having a curved tenon and a curved mortise at an edge opposite to the edge shown in FIG. **53**, in accordance with one embodiment of the invention;

FIG. **56** is a structural diagram of another part of the floorboard of FIG. **53** having a straight tenon and a straight mortise at its one of two edges connecting in-between the edge shown in FIG. **53** and the edge shown in FIG. **55**, in accordance with one embodiment of the invention; and

FIG. **57** is a structural diagram of another part of the floorboard of FIG. **53** having a straight tenon and a straight mortise at an edge opposite to the edge shown in FIG. **56**, in accordance with one embodiment of the invention;

DETAILED DESCRIPTION OF THE EMBODIMENTS

For further illustrating the invention, experiments detailing a joint structure for assembling floorboards are described below. It should be noted that the following examples are intended to describe and not to limit the invention.

As shown in FIGS. **1-3**, a joint structure for a floorboard, comprises: at least one first beveled tenon **11**, the first beveled tenon **11** comprising a tenon face facing upwards; a first beveled mortise **12**, the first beveled mortise **12** comprising a mortise face facing upwards; at least one second beveled tenon **13**, the second beveled tenon **13** comprising a tenon face facing downwards; and a second beveled mortise **14**, the second beveled mortise **14** comprising a mortise face facing downwards. The first beveled tenon **11** is disposed in parallel to a surface of the floorboard at a right edge approximately half a height of the floorboard. The first beveled mortise **12** is disposed at an inner side of the first beveled tenon **11**. The second beveled tenon **13** is disposed at a left edge approximately half the height of the floorboard. The second beveled mortise **14** is disposed at an inner side of the second beveled tenon **13**. The first beveled tenon **11** matches with the second beveled mortise **14**. The second beveled tenon **13** matches with the first beveled mortise **12**. An outer side of the first beveled tenon **11** and an inner side of the second beveled mortise **14** form a first interlock mechanism. An outer side of the second beveled tenon **13** and an inner side of the first beveled mortise **12** form a second interlock mechanism. In assembling, the first beveled tenon **11** and the first beveled mortise **12** of a first floorboard **1** match with the second beveled mortise **14** and the second beveled tenon **13** of a second floorboard **2**, respectively; and the two floorboards are further interlocked by the first interlock mechanism and the second interlock mechanism.

As shown in FIG. **1**, the second interlock mechanism is formed by arranging tooth-shaped tenons **15***a*, **16***a* respectively on the inner side of the first beveled mortise **12** and the outer side of the second beveled tenon **13**, allowing a tooth top line and a tooth bottom line of each of the tooth-shaped tenons **15***a*, **16***a* to be in parallel with the surface of the floorboard, and engaging the two tooth-shaped tenons **15***a*, **16***a* with each other. The first interlock mechanism is formed by arranging tooth-shaped tenons **16***b*, **15***b* respectively on the outer side of the first beveled tenon **11** and the inner side of the second beveled mortise **14**, allowing a tooth top line and a tooth bottom line of each of the tooth-shaped tenons **15***b*, **16***b* to be in parallel with the surface of the floorboard, and engaging the two tooth-shaped tenons **15***b*, **16***b* with each other. The first beveled tenon **11** and the first beveled mortise **12** of the first floorboard **1** match with the second beveled mortise **14** and the second beveled tenon **13** of the second floorboard **2**, respectively; and the two floorboards are further interlocked and clamped by the first interlock mechanism and the second interlock mechanism.

As shown in FIG. **2**, the second interlock mechanism is formed by arranging a trapezoidal blind mortise **17***a* on the inner side of the first beveled mortise **12** and a trapezoidal tenon **18***a* on the outer side of the second beveled tenon **13**, respectively, and matching the trapezoidal blind mortise **17***a* and the trapezoidal tenon **18***a* with each other. The first interlock mechanism is formed by arranging the trapezoidal tenon **18***b* on the outer side of the first beveled tenon **11** and a trapezoidal blind mortise **17***b* on the inner side of the second beveled mortise **14**, respectively, and matching the trapezoidal blind mortise **17***b* and the trapezoidal tenon **18***b* with each other. The first beveled tenon **11** and the first beveled mortise **12** of the first floorboard **1** match with the second beveled mortise **14** and the second beveled tenon **13** of the second floorboard **2**, respectively; and the two floorboards are further interlocked and clamped by the first interlock mechanism and the second interlock mechanism.

To avoid swell phenomenon between the trapezoidal blind mortise **17***a*, **17***b* and the trapezoidal tenon **18***b*, **18***a*, a deformation structure is designed. The deformation structures is formed between the trapezoidal tenon **18***b*, **18***a* arranged on the outer side of either the first tenon **11** or the second tenon **13**, and corresponding edge of the floorboard. A deformation structure comprises: a triangular ridge **18***c* comprising a sharp edge **18***e* (as shown in FIGS. **3-4**), or a rectangular ridge **18***d* comprising a sharp edge **18***e* (as shown in FIGS. **5-6**). The sharp edge **18***e* leans against a beveled line **17***c* of the trapezoidal blind mortise **17***b* so as to form a line contact. An expansion joint is formed between the other two sides of the triangular ridge **18***c* or the other three sides of the rectangular ridge **18***d* for avoiding contact.

In the process of assembly the floorboards, dovetail tenon-and-mortise joint are added on two ends that are intersected with the ends provided with the beveled tenon-and-mortise joint so as to increase the strength in a direction in perpendicularity to a grain. As shown in FIG. **7**, dovetail mortises **23** are arranged on the upper part and the lower part of each of the front edge and the rear edge of the first floorboard **1** and the second floorboard **2**; and each of the dovetail mortises **23** is provided with the dovetail tenon strip **24**.

The interlock mechanism can be other structures, such as a structure comprising a rectangular tenon and a rectangular blind mortise, and a structure comprising a sharp corner-tenon and a rectangular sharp corner.

One or more beveled tenons and beveled mortises matched with each other can be designed. As shown in FIG. **3**, the invention comprises a plurality of beveled tenons and corresponding mortises that have the same slope. The structure comprising the trapezoidal blind mortise and the trapezoidal tenon is employed.

FIG. **8** is a lateral view of assembled two floorboards.

As shown in FIGS. **9-10**, the floorboard comprises: a front edge comprising a straight tenon **19** on an upper part and a straight blind mortise **21** on a lower part; and a rear edge comprising a straight blind mortise **21** on an upper part and a straight tenon **19** on a lower part.

FIG. **11** is a laterally sectional view of two assembled floorboards.

FIG. **12** is a top view of a floorboard.

FIG. **13** is a top view of assembled floorboards.

The joint of the invention can used to assemble veneers, an axonometric drawing of veneers comprising beveled tenon-and-mortise joints before assembly is shown in FIG. **14**.

The joint of the invention can also used to assemble planks, a structure diagram of planks comprising beveled tenon-and-mortise joints before assembly is shown in FIG. **15**. FIG. **16** is a structure diagram of planks comprising beveled tenon-and-mortise joints after assembly. FIG. **17** is a top view of planks comprising beveled tenon-and-mortise joints after assembly.

Another joint structure for a floorboard, comprises: at least one first curved tenon **29**, the first curved tenon **29** comprising a tenon face facing outwards; a first curved mortise **30**, the first curved mortise **30** comprising a mortise face facing outwards; at least one second curved tenon **29**, the second curved tenon **29** comprising a tenon face facing outwards; and a second curved mortise **30**, the second curved mortise **30** comprising a mortise face facing outwards. The first curved tenon **29** is disposed inclined to a surface of the floorboard at a right edge approximately half a height of the floorboard; the first curved mortise **30** is disposed at an inner side of the first curved tenon **29**. The second curved tenon **29** is disposed at a left edge approximately half the height of the floorboard; the second curved mortise **30** is disposed at an inner side of the second curved tenon **29**. The first curved tenon **29** matches with the second curved mortise **30**. The second curved tenon **29** matches with the first curved mortise **30**. An outer side of the first curved tenon **29** and an inner side of the second curved mortise **30** form a first interlock mechanism. An outer side of the second curved tenon **29** and an inner side of the first curved mortise **30** form a second interlock mechanism. In assembling, the first curved tenon **29** and the first curved mortise **30** of a first floorboard **1** match with the second curved mortise **30** and the second curved tenon **29** of a second floorboard **2**, respectively; and the two floorboards are further interlocked by the first interlock mechanism and the second interlock mechanism.

Herein a composite floorboard (as shown in FIG. **37**) comprising the curved tenon-and-mortise joint **12** and a tapered tenon-and-mortise joint **13** are described.

The curved tenon-and-mortise joint as shown in FIG. **44** comprises: a curved tenon **29** and a curved mortise **30**, auxiliary matching structures comprising a stitching tenon **16** and a stitching mortise **15**, and a curved corner **28**.

The tapered tenon-and-mortise joint **13** (as shown in FIG. **38**) comprises: a tapered tenon **23**, **25** and a tapered mortise **24**, **26**, and an auxiliary matching structure comprising a stitching tenon **16***a* and a stitching mortise **15***b*.

Floorboards employing the two kinds of joints are superior to those employing the same tenon-and-mortise joints but totally different from those conventional ones employing different tenon-and-mortise joints. The curved tenon-and-mortise joint as shown in FIG. **44** has a smaller space of 5 mm compared to the conventional joints of 12 mm. The finished product rate exceeds two times of that of the conventional ones, thereby largely improving the finished product rate of the floorboards. Furthermore, the floorboards after being assembled have sealed joints and high integration and strength. Because the two floorboards have the same tenon-and-mortise joints on the same side, the assembly and disassembly of the floorboards are very convenient.

The tapered tenon-and-mortise joint as shown in FIGS. **38-39** is assembled by a method of unilateral axis rotating, which obviously different from the conventional stitching principles. The assembly of the tapered tenon-and-mortise joint is realized by slight deformation. The tapered tenon-and-mortise joint of the invention has a much simpler structure, no obvious grooves, and high integration and strength.

Process for assembling composite floorboard comprising the curved tenon-and-mortise joint **12** and the tapered tenon-and-mortise joint **13** is as follows: place the curved tenon **29** of a first floorboard into the curved mortise **30** of another floorboard. Move the two floorboards in opposite directions along a stitching line to match with each other. Move in horizontal direction after being lifted by two curved corners **28**, control a horizontal movement within a range of the curved tenon **29** (that is, a width of a conventional expansion joint of floor corner is approximately 5 mm) Process for joint the curved tenon and the curved mortise are shown in FIGS. **41-43**. Match the tapered tenon-and-mortise joint while moving, using the matching curved tenon-and-mortise joint as an axis to lifting the curved tenon-and-mortise joint of an opposite end. The match of the curved tenon-and-mortise joint realizes the stitching of the stitching tenon **16** and the stitching mortise **15** during which the tapered tenon-and-mortise joint moves downwards to realize the stitching of the stitching tenon **16***a* and a stitching mortise **15***b*, as shown in FIGS. **38-39**. Thus, the assembling composite floorboard comprising the curved tenon-and-mortise joint **12** and the tapered tenon-and-mortise joint **13** are finished.

FIGS. **46-50** are structure diagrams of milling cutters of different shapes for machining a curved tenon-and-mortise joint. FIG. **52** is a structure diagram of different milling cutters shaping different positions of a curved tenon-and-mortise joint. A machining path of a milling cutter of shape E is shown in FIG. **51**. Machining paths of other milling cutters of different shapes (such as shape A, shape B, shape C, and shape D) are straight lines. FIG. **53** is a structure diagram of a part of a floorboard having at its one edge a curved tenon **531** and a curved mortise **532**. FIG. **54** is a structure diagram of a curved tenon-and-mortise joint with specific dimensions. FIG. **55** is a structural diagram of another part of the floorboard of FIG. **53** having a curved tenon **533** and a curved mortise **534** at an edge opposite to the edge shown in FIG. **53**. FIG. **56** is a structural diagram of another part of the floorboard of FIG. **53** having at its one edge a straight tenon **535** and a straight mortise **536**. FIG. **57** is a structural diagram of another part of the floorboard of FIG. **53** having a straight tenon **537** and a straight mortise **538** at an edge opposite to the edge shown in FIG. **56**.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

The invention claimed is:

1. A joint structure adapted to be disposed on a support surface for a flooring, the joint structure comprising a first floorboard and a second floorboard; the first floorboard and the second floorboard each comprising: a top surface;

a bottom surface;

a first side surface

a second side surface;

a third side surface; and

a fourth side surface;

a first curved tenon disposed at the first side surface, the first curved tenon comprising a first tenon face;

a first curved mortise disposed at the first side surface, the first curved mortise comprising a first mortise face;

a second curved tenon disposed at the second side surface, the second curved tenon comprising a second tenon face; and

a second curved mortise disposed at the second side surface, the second curved mortise comprising a second mortise face;

wherein:

the bottom surface is adapted to be in contact with the flooring the support surface and is adapted to be arranged substantially parallel to the flooring support surface;

the top surface is disposed substantially parallel to the bottom surface; the first side surface, the second side surface, the third side surface, and

the fourth side surface are disposed substantially perpendicular to the bottom surface;

the first side surface is disposed opposite to the second side surface;

the third side surface is disposed opposite to the fourth side surface;

the third side surface connects between the first side surface and the second side surface;

the fourth side surface connects between the first side surface and the second side surface;

the first curved tenon is obliquely disposed on the first side surface at approximately half a height of the first floorboard or the second floorboard; the first curved mortise is disposed at an inner side of the first curved tenon;

the second curved tenon is obliquely disposed on the second side surface at approximately half the height of the first floorboard or the second floorboard; the second curved mortise is disposed at an inner side of the second curved tenon;

a boundary surface between the first curved tenon and the first curved mortise is in a wave shape and comprises a first convex part and a first concave part, wherein the uppermost point of the first convex part is disposed higher than the lowermost point of the first concave part with respect to the support surface;

a distance between the uppermost point of the first convex part and a portion of the first side surface closer to the support surface is greater than a distance between the lowermost point of the first concave part and the portion of the first side surface closer to the support surface;

a boundary surface between the second curved tenon and the second curved mortise is in a wave shape and comprises a second convex part and a second concave part, wherein the lowermost point of the second convex part is disposed lower than the uppermost point of the second concave part with respect to the support surface;

a distance between the lowermost point of the second convex part and a portion of the second side surface closer to the support surface is shorter than a distance between the uppermost point of the second concave part and the portion of the second side surface closer to the support surface;

the first tenon face is adapted to fit with the second mortise face;

the second tenon face is adapted to fit with the first mortise face;

an outer side of the first curved tenon of the first floorboard and an inner side of the second curved mortise of the second floorboard form a first interlock mechanism;

an outer side of the second curved tenon of the first floorboard and an inner side of the first curved mortise of the second floorboard form a second interlock mechanism; and

in assembling, the first curved tenon and the first curved mortise of the first floorboard fit with the second curved mortise and the second curved tenon of the second floorboard, respectively; and the first and second floorboards are interlocked by the first interlock mechanism and the second interlock mechanism.

2. The joint structure of claim **1**, wherein the first curved tenon and the second curved tenon have the same slope.

3. The joint structure of claim **1**, wherein a straight tenon is disposed on an upper part of the third side surface, a straight blind mortise is disposed on a lower part of the third side surface, a straight blind mortise is disposed on an upper part of the fourth side surface, and a straight tenon is disposed on a lower part of the fourth side surface.

4. The joint structure of claim **1**, wherein the first floorboard and the second floorboard are identical.

5. The joint structure of claim **1**, wherein in assembling, the first convex part of the first floorboard is fit with the second concave part of the second floorboard, and the first concave part of the first floorboard is fit with the second convex part of the second floorboard.

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